Sustainable Collaborative Research Activities:

A System's Approach to the implementation of e- Conferencing for Lower Carbon Footprint

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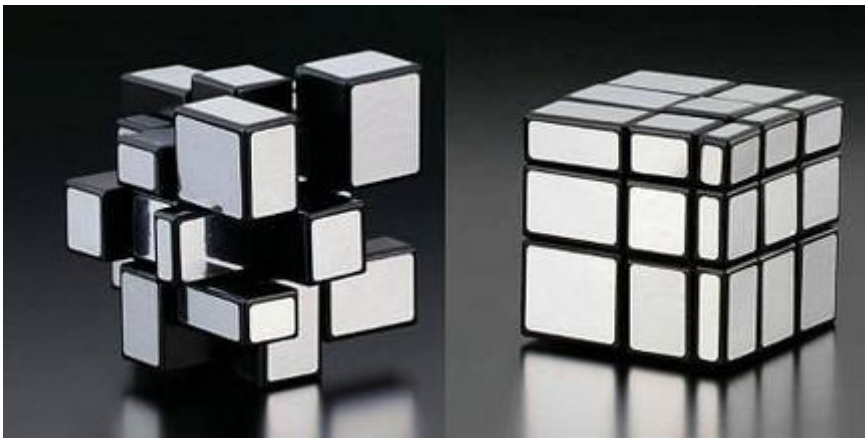

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Acknowledgement

I would like to thank all those who took the time to respond to my survey.
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Executive summary

Introduction

The benefits of saving time, money, and reducing carbon footprint entailed in using e-collaborative technologies for remote research has been appreciated by individuals, industry, universities, and governments(Thorns, Allan M., White, & Zeiher, 2009). Organisations and individuals express wishes to utilise the technology for establishing sustainable research practices where increased use of e-collaborative technologies reduces the need for travel (Thorns, Allan, Barclay, Chamberlain, Kerr, & Scott, 2008).

Transferring these aspirations to practise has often been addressed using the '*if you build it they will come'* model, where the provision of e conferencing technology is believed to instigate changes in practices and the replacement of face- to- face meetings with virtual ones. More comprehensive approaches where non technical variables were addressed tended to follow a binary trend which classified variables as *drivers and barriers (*Markard & Truffer, 2008; Parente & Prescott, 1994; Strewart & Mohamed, 2004*).*

The lower than anticipated uptake of e- conferencing technologies depicted in literature, (Allan & Thorns, 2008, 2009; Frost & Sullivan., 2005; Hirsh, Sellen, & Brokopp, 2005; Sankar, 2006; Vilaboy, 2007) raises questions as to the effectiveness of the approaches applied so far.

The report proposes a break away from binary based approaches, and argues that processes of adopting technology should be viewed as *complex systems* comprised of interdependent relationships between various factors. The report argues that attempting to isolate factors leads not only to a limited but at times misleading view of what is driving the uptake and what is contributing to its effectiveness, hence hindering the ability to identify the most effective actions needed to be taken in order to facilitate effective implementation. The report acknowledges that to enable effective implementation using a system based approach where multiple interrelating factors need to be addressed simultaneously poses strategic difficulties for organisations. To address these difficulties the report proposes a method which enables the prioritisation rather than segregation of factors. The method identifies relationships between factors and clusters them into *factor systems*. These are prioritised by measuring the robustness of their relations within the Greater system encompassing the process as a whole.

The report demonstrates the new method using data from a case study in which uptake of e-collaborative tools for conducting remote collaborative research was investigated through the identification of technical and non technical factors and the discovery of the relationships between them.

Theoretical framework

The report breaks away from binary models and adopts notions of Systems' Thinking. It looks at technical and non technical variables as systems of factors which need to be addressed as interdependent rather than segregated entities entailed in processes of uptake of e-conferencing technologies and the shift in practices. Using System Theory approach provides a view of e- conferencing as assembled from numerous technological aspects, and the use of the technology by people as creating human machine relations. Both technology and human

machine aspects are embedded in interrelating financial economic social and political issues, all of which are operating as complex networks creating systems(Bertalanffy, 1971).
The uptake of e conferencing and the shift in practices it enables is perceived here as an *emergent phenomenon* (Miller & Page, 2007), which encompasses many levels generated by aggregates of technical and non technical factors forming *Factor Systems* which link together to form the bigger picture of the uptake process as a complex system.

Aims of the project

The aim of the project is to provide a way of looking at uptake processes as complex systems rather than binary situations where isolated variables are seen as either needing to be facilitated or resolved in order for uptake to be successful. This is of particular importance in the context in which uptake of e-conferencing is expected to occur.

The aim of the project is to provide a framework for the study of the uptake of e conferencing technology as embedded in the context of today's knowledge economy/society. This context requires transnational research links but at the same time operates in a society concerned with an environmental crisis, and demanding 'green' practices. This context produced popular assertions claiming that:

a. The knowledge economy requires researchers to work collaboratively across geographical and disciplinary distances
b. Carbon footprint could be reduced through the use of e-conferencing technologies. Face to face (F2F) meetings could be complimented or at times replaced by virtual ones, hence reducing the need for travel and consequently the carbon emissions associated with it while at the same time maintaining high connectivity between collaborators
c. Prevalent and available e-conferencing technologies will lead to wide use and encourage change in practices

Through the adoption of System Theory the project aims to develop a method which provides a view of the ways in which these assertions are played out in the perceptions and practices of the research community and the links between these and the uptake of e conferencing technologies.

The report presents the perceptions about the need for collaboration, the ways in which the need is expressed, what practices and technologies are used for addressing it, and whether practices are guided or driven by environmental concerns about the carbon footprint.

Methodology

The report presents the findings of an online survey and fourteen semi structured interviews. Both the survey and interviews targeted a study population representing three categories of respondents: those developing technology, those advocating the use of e- conferencing technology for e-collaboration, and those calling for environmentally friendly solutions. The survey was disseminated online in a manner facilitating *snow ball* effect. This resulted in a worldwide spread reaching researchers based in various parts of the globe.

The survey questions addressed three operational **statuses** relating to the use of e-conferencing technologies:

1. *Perception status*- Identified through survey questions in which participants were asked to: explain their choice of technology, describe notions associated with use of

technology for collaborative remote research, and convey feelings, opinions, and expectations

2. *Practices status* - Identified in survey questions where participants were asked to choose activity, or tool, or alternatively note availability of a technology, a norm, or a practice
3. *Expressions status*- Identified in survey questions where participants described situations in the work place

Survey questions provided quantitative and qualitative data. The quantitative data is presented in graphs representing:

- Access to technology,
- Familiarity with e conferencing technologies,
- Perceptions of effectiveness of technologies,
- Choice of technologies
- Choice of platform for participation in conferences

The analysis of the qualitative data led to the identification of the various factors underpinning the aspects depicted in the quantitative graphs.

The findings of the qualitative data are organised in a manner which highlights their interrelatedness, and consequently the identification of factors as members of systems. The organisation of the factors in this way laid the foundations for the development of a new method of analysing uptake processes.

The method used for organising the factors facilitated their presentation not as individual entities but rather as systems of factors. The method provides a non binary perspective of the process of uptake, and enables a multi level view of the process as emerging from within the relationships of factors within their systems as well as through the relationships between the various *factor systems* creating the process as a whole.

The method demonstrated here dissects systems comprising processes of uptake and offers a clearer view of what is entailed in the *emergence*(Miller & Page, 2007) of such processes as wholes. It contributes to our understanding of how systems comprising processes are created through the various interrelating parts

The ability to follow the emergence as created through these different levels of systems allows for disassembly of the whole at different points(Miller & Page, 2007). This ability facilitates informed intervention for successful implementation of e conferencing technologies. However, it also poses strategic difficulties in addressing multiple factors embedded in one or more *factor systems* all at once. To address these difficulties the method identifies the impact value of the various *factor systems* hence creating a prioritisation mechanism. This mechanism allows decision makers to design different phases in an implementation plan based on the priority levels of factor systems. Priority levels are established in accordance with the level of prominence a *factor system* displays within the Greater system. The prioritisation strategy facilitates localised yet interlinked approach and provides a systemic approach to the implementation of e- conferencing.

The prioritisation of factors is obtained through the adoption of concepts found in Social Network Analysis' Centrality and Cohesion routines, and is illustrated using Graph theory.

Findings

The survey and interviews set out to identify and map the various factors entailed in the uptake of e- conferencing technologies within the context of a knowledge society/economy which requires collaborative research but at the same time is calling for environmentally friendly solutions, and the reduction of travel related emissions.

The investigation contributes to the field of study challenging the assumption that the provision of remote collaborative technologies will alter existing practices and promote e-conferencing as a mean for sustainable collaborative research, arguing that non technological factors need to be addressed in order for technologies to be adopted(Allan & Thorns, 2009; Bayo-Moriones & Lera-Lo´ pez, 2007; Davis, 1989; A.. Dillon & M.. G. Morris, 1996; Greenberg, 2009; Markard & Truffer, 2008; Parente & Prescott, 1994; Strewart & Mohamed, 2004; Van Akkeren & Cavaye, 1999). The findings here reiterate these arguments further suggesting that the technology itself will not trigger uptake of e collaborative research, but rather as one respondent put it:

"The ethos, the culture, the colleagues and the tools … in that order"

The focus here is on searching for a way that will contribute to our understanding of how various factors involved in the process relate to each other, and in so doing will contribute to findings ways of transferring rhetoric into practice.

Table 1 summarises key statements made by participants in this study and exposes the inconsistencies between the rhetoric and practice. The rhetoric expresses acknowledgement of the benefits entailed in using technology for collaborative research. However, the practices constructed through factors associated with collaborative practice and those associated with users' technology relationship do not portray implementation of the rhetoric.

Table 1- Rhetoric and Practice

Rhetoric	Practice
People enjoy collaboration	Career structures and evaluation models promote individualistic competitiveness hence deterring people from collaborating
People are wired to collaborate	Different cultures sometimes cause difficulties for the collaboration "Its tough to arrange"
People see the benefits in collaboration as increasing diversity, efficiency and providing stimuli	Collaboration is a buzzword, doing it for compliance is a waste of time There is no tangible reward for collaborative practices
Work is increasingly multidisciplinary	Career success is measured by discipline based publications which provide higher impact factor and therefore are more desirable
Organisation see collaboration as beneficial for purposes of securing funding and acquiring prestige	No real incentives provided Organisations do not see benefits of collaboration for the project

Rhetoric	Practice
81.2% of the respondents said that their organisation encourages collaboration	Officially organisations encourage collaboration but do not provide sufficient institutional and cross-institutional backing. Collaboration is not given a high importance and most collaboration is imitated by individuals
Organisations seem to have a strong sense of the potential benefits entailed in collaboration	Organisation lack a sense of what collaboration could /should mean and as a result there is no tangible reward for collaborative practices.
Organisations see the benefits in using e conferencing technologies for reducing travel	57.4% of organisations do not seem to promote the shift to e conferencing.
People see the benefits in video conferencing because it saves time and travel and more friendly to the environment	People refrain from using video conferencing because of technological challenges; lack of support; no time to train and get proficient in its use; costs; consumes time for setting up; need technician on site; compatibility and interoperability with systems of collaborators; time zone issues prevent using workplace high speed network facilities and technical support.
People prefer face to face meeting over all other media because of the richness of the communication which enables building trust and establishing initial contacts. Literature suggests that video conferencing is the next best thing to face to face meetings.	The most ubiquitous medium used for remote collaboration is email, which literature rates very low in media richness. Reasons given for the use of email are: 1. Most available 2. Most familiar 3. Perceived as most effective 4. Is rated second to face-to-face in level of enjoyment 5. Convenient- simple and immediate 6. Not intrusive to other tasks 7. Easy to use

In highlighting the inconsistencies between rhetoric and practice table 1 illustrates the non linear flow between the various practices, and the complexity entailed in the process of adopting sustainable collaborative research practices.

The report presents the findings of the survey questionnaire and the responses to the interviews in a manner which carves out the different networks and systems emerging from the data.

- The smallest unit identified are *statements* made by respondents in the study.
- These are clustered into various *factors*
- Factors are associated with agencies and operational statuses forming *Factor Systems*
- Various *Factor Systems* are networked through agencies and operational *statuses* to form the *Greater System* encompassing the implementation processes as a whole.

Figure 1 illustrates the emergence of the Greater system.

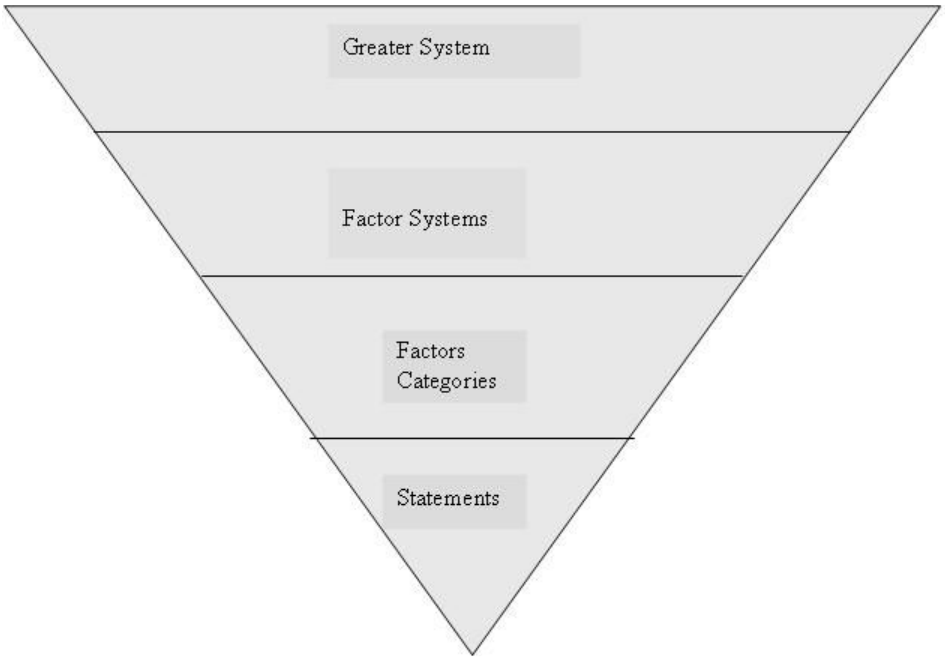


Figure 1-The emergence of the Greater System

The organising of the findings follows the structure of the survey questionnaire reflected in the division into the three operational *statuses*; perceptions, practices, expressions. An additional layer of organisation is revealed through content analysis of the statements identified in the qualitative data. This exposed three agencies implied in the wording of the responses to the open ended questions: Actors, Organisations and Technology

- Actor – representing individuals,
- Organisation –representing workplace
- Technology – representing all technology associated factors

In addition the analysis revealed that some factors could be associated with more than one agency, for example, factors that could relate to actor and organisation were categorised as Actor/Organisation, others as Actor/ Technology, Organisation/Technology, or Actor/Organisation/Technology

The organisation of the findings depict the Greater system as comprised of interrelating elements such as agencies, statuses and the technology itself as shown in figure 2

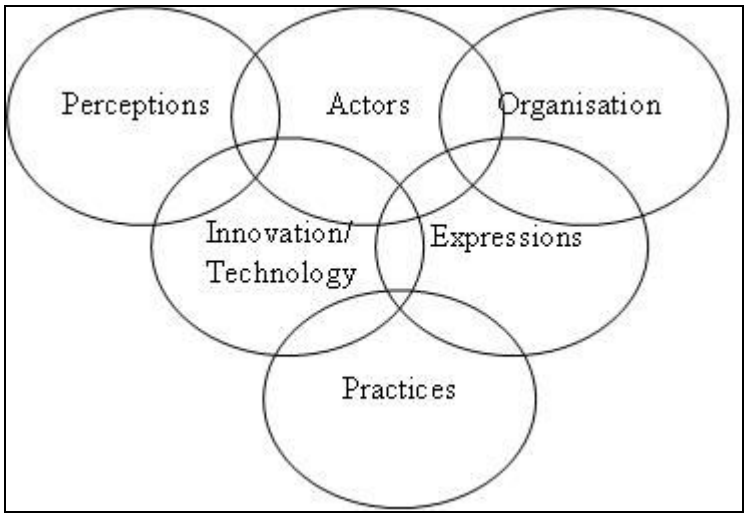


Figure 2: The elements of the Greater System

The report identifies a total of 140 qualitative statements representing the key issues raised by participants in the study. The extraction of these statements was done by trolling the qualitative parts of the survey and transcribing the interviews. Duplicating ideas were eliminated. The 140 statements were clustered into 29 factors showing here:

1. Barriers to collaboration
2. Collaboration value for Complexity
3. Collaborative culture
4. Collaborators
5. Competitiveness
6. Context
7. Diversity
8. Efficiency
9. Environment
10. Expectations of e conferencing
11. Face-to-Face
12. Funding
13. Going virtual
14. Human Nature and Collaboration
15. Multidisciplinary
16. Networking
17. Organisational support
18. Quality of work
19. Rhetoric Practice gap
20. Standard practice
21. System of factors
22. Task Technology
23. Technological support
24. Technology Availability
25. Technology Reliability
26. Time
27. Travel
28. User Technology
29. Work Relations

The links between the various statements, *statuses* and *agencies* clustered under a *factor* are mapped to reveal which statement relate to what statuses and agencies. This mapping outlines the structure of the *factor system.* Figure 3 demonstrates a *factor system* using the statements

aggregated under the "Barriers to Collaboration" factor. The circles in the illustration represent the *statements,* the boxed circles represent the *agencies*, and the boxes represent the *statuses*.

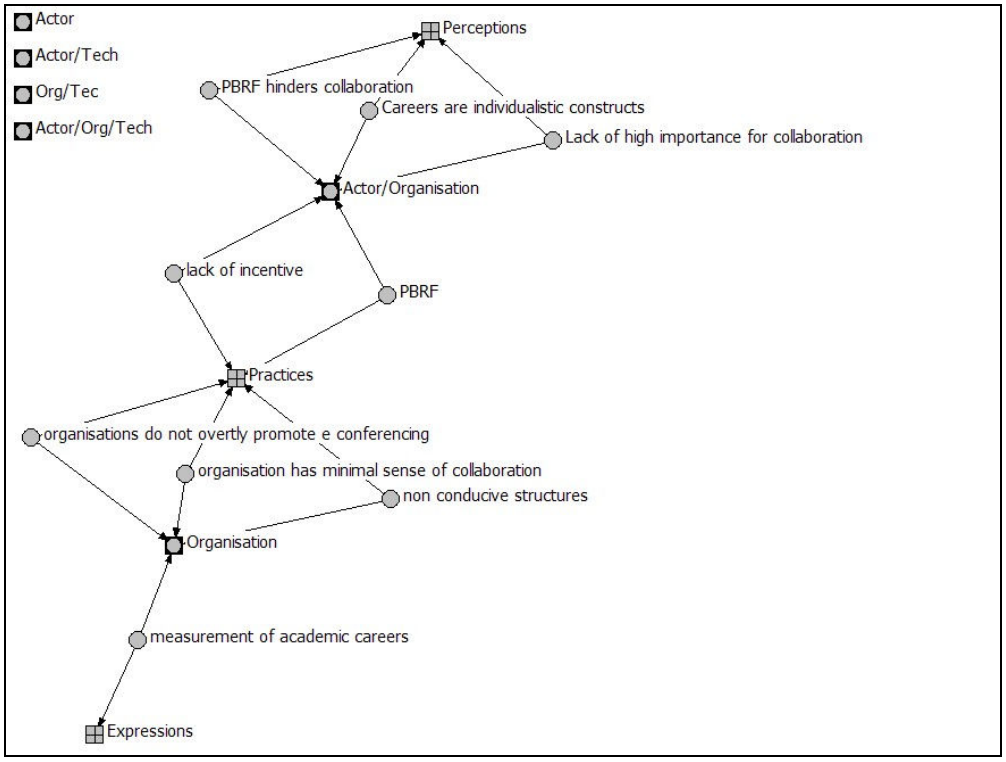


Figure 3- Factor System- Barriers to Collaboration

Each factor is mapped this way linking its associated statements with *agencies* and *statuses.* Table 2 depicts the number of statements associated with agencies and statuses identified within each *factor System* across the whole of the Greater system.

The acronyms used in the table 2 are as follows:
A=Actor
O=Organisation
AO=Actor Organisation
AT= Actor Technology
OT=Organisation Technology
AOT=Actor Organisation Technology
# = Number of statements clustered under the factor

Table 2- Totals in Factor Systems

Factors	Perceptions	Practices	Expressions	Total statements to factor
Barriers to collaboration	AO3	O3, AO2	O1	9
Collaboration value for Complexity	A1, AO1	AO1	O1	4
Collaborative culture	O3, AO6	O4, AO4	O1	18
Collaborators	AO1	AO3	AO2	6
Competitiveness	O1	O1		2
Context	O1	O1		2
Diversity	A1, AO1	A1, AO2		5

Factors	Perceptions	Practices	Expressions	Total statements to factor
Efficiency	O1	O2		3
Environment		AO2		2
Expectations of e conferencing	AO2	AO2		4
Face-to-Face		A1, AT1		2
Funding	AO1	O5, AO2, OT2	O1	11
Going virtual		AO5		5
Human Nature and Collaboration	A3	A2		5
Multidisciplinary		O1	O1, AO1	3
Networking	A1, AO1	A1, AO1	AO1	5
Organisational support		OT1		1
Quality of work	AO5			5
Rhetoric Practice gap	O2	O2		4
Standard practice	O2, AO1	O1	O2	6
System of factors	AOT1			1
Task Technology		AT4, AOT1,AO1		6
Technological support	OT1	OT3, AOT1		5
Technology Availability	OT1	OT1, AOT4		6
Technology Reliability		AT1, OT1		2
Time	AO1	AO1		2
Travel		A2		2
User Technology		AT10, AOT3		13
Work Relations	AO1			1
Total				140

Figure 4 illustrates how the various factor systems are linked through *agencies* and *statuses* which provide mutual channels through which all factor systems can potentially link to provide a view of the Greater system showing the uptake system as a whole. Each factor system in figure 4 is represented by factor titles. The lines show how various factor systems link through the *agencies and statuses*.

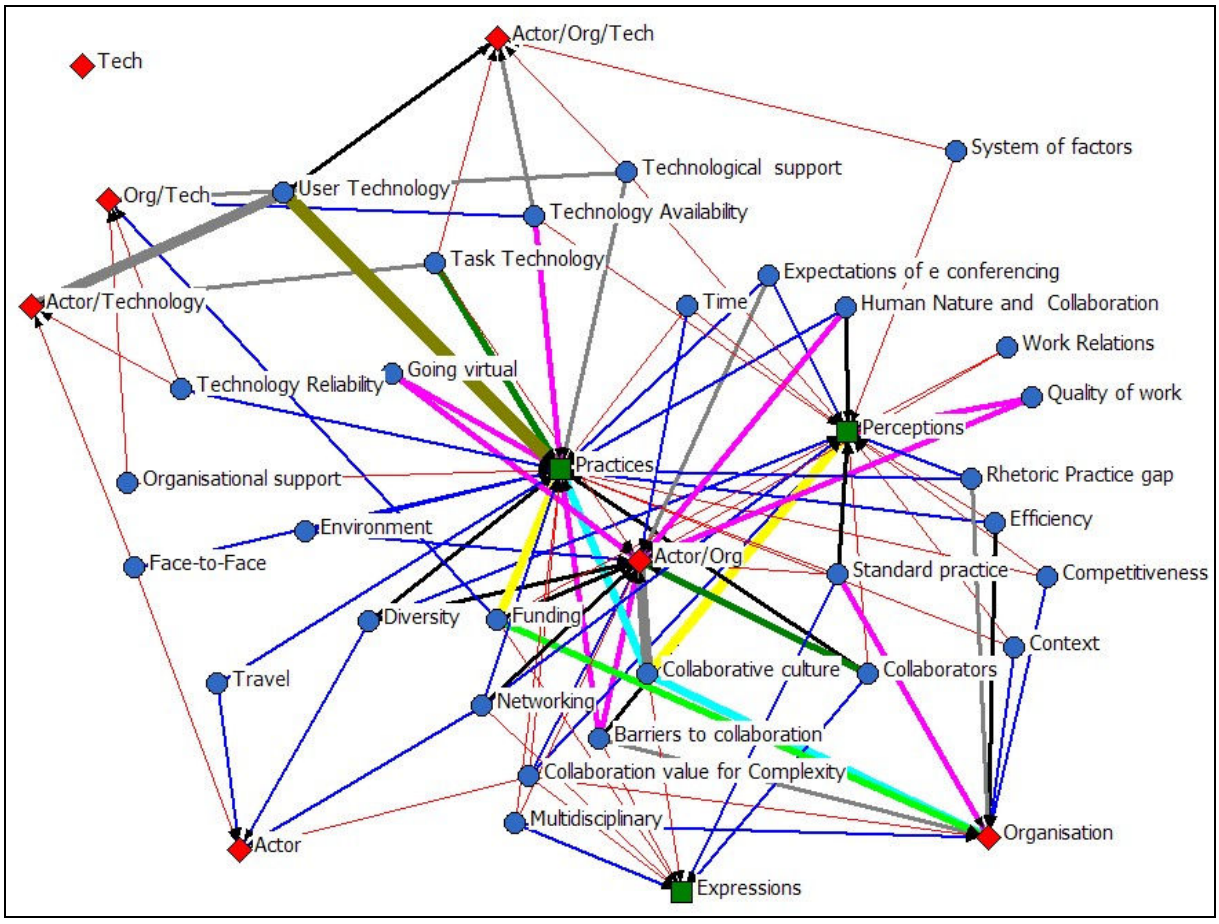


Figure 4 - The Greater System

The thickness of lines illustrated in figure 4 depicts the strength of the relationships between each factor system and other elements in the system- "The thicker the line, the stronger the tie". Thickness is determined by the number of statements associated with each element as shown in Table 3.

Table 3- Statements per Factor

Factors	Perceptions	Practices	Expressions	Actor	Actor/Org	Organisation	Actor/Technology	Org/Tech	Actor/Org/Tech	Tech
Barriers to collaboration	3	5	1		5	4				
Collaboration value for Complexity	2	1	1	1	2	1				
Collaborative culture	9	8	1		10	8				
Collaborators	1	3	2		6					
Competitiveness	1	1				2				
Context	1	1				2				
Diversity	2	3		2	3					
Efficiency	1	2				3				
Environment		2			2					
Expectations of e conferencing	2	2			4					
Face-to-Face		2		1			1			
Funding	1	9	1		3	7		2		
Going virtual		5			5					
Human Nature and Collaboration	3	2			5					
Multidisciplinary		1	2		1	2				
Networking	2	2	1	2	3					
Organisational support		1						1		
Quality of work	5				5					
Rhetoric Practice gap	2	2				4				
Standard practice	3	1	2		1	5				
System of factors	1								1	
Task Technology		6			1		4		1	
Technological support	1	4						4	1	
Technology Availability	1	5						2	4	
Technology Reliability		2					1	1		
Time	1	1			2					
Travel		2		2						
User Technology		13					10		3	
Work Relations	1				1					

Table 3 is a valued matrix of Table 2, and illustrates the spread of statements in a factor system across each element.

Figure 5 demonstrates the translation of the data showing in Table 3 to a network graph using a single factor system "barriers to collaboration".

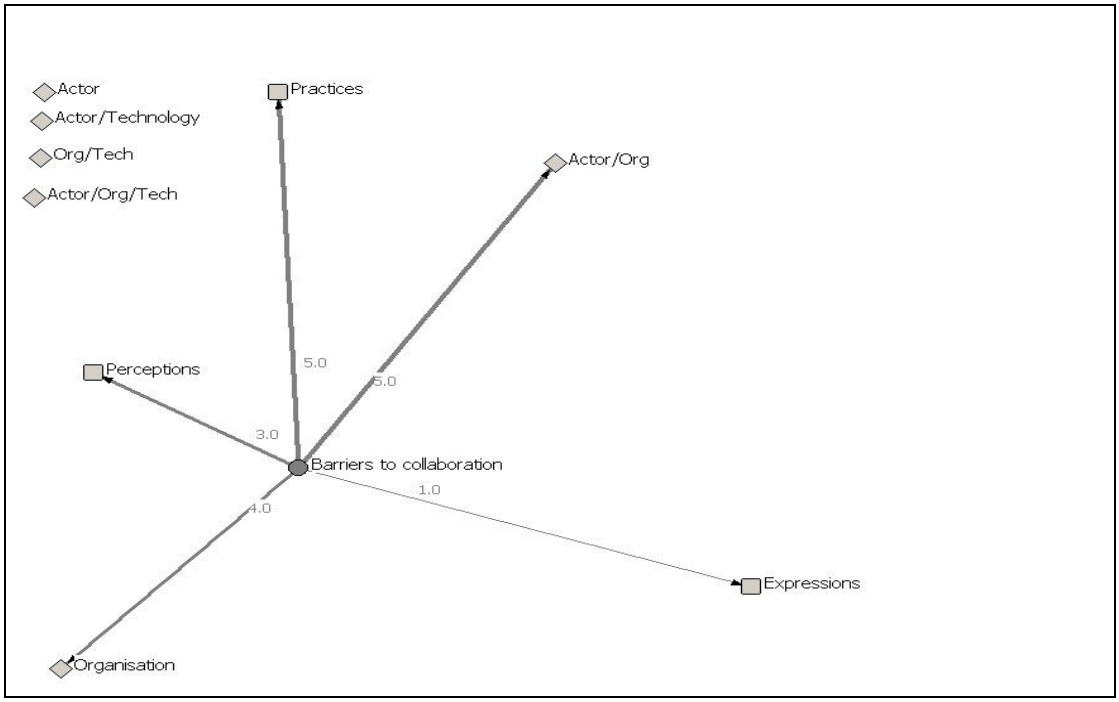


Figure 5- Value Links

The wider the spread of statements across elements in the system the more ties are associated with it, and the higher its prominence or *Centrality*

Analysis of the Greater System- the Prioritisation of *factor systems*

The thickness of ties, the position of the various factor *systems* illustrated in the Greater System (figure 4), and its relations to other elements in the Greater system marks the centrality of each *factor system* and consequently the impact value it holds in relation to the process as a whole. Identifying the centrality of a *factor system* facilitates the prioritisation of highly central system factors over low centrality ones. The prioritisation of factor systems facilitates addressing parts of the whole but not by dealing with individual factors but by addressing *factor systems* as subsystems of the Greater system representing the process as a whole.

Analysing the visual illustration of the Greater system it is apparent that technology can never be seen as an independent entity. Figure 4 shows that technology in itself was excluded from the system because it was never mentioned as an isolated entity in the findings. The illustration shows a thick tie link between the factor system *user technology* and *practices*. Thickness of a tie indicates high number of statements associated with the factor, and may imply importance, however, Social Network Analysis approach would argue that importance of a node in a network is often decided by the number of ties it has across other nodes in the network. Nodes showing high numbers of relations to other nodes are defined prominent nodes, denoting that they have extreme involvement with other nodes and are therefore

perceived as highly central, or in Social Network Analysis terminology, hold high *Centrality* levels (Wasserman & Faust, 1994).

The most prominent factor systems are:

1. Collaborative Culture with a total number of 36 ties
2. User technology with a total number of 26 ties
3. Funding with a total number of 22 ties
4. Barriers to Collaboration with a total number of 18 ties

Conclusions

The report shows that technology in itself does not drive change.

The most prominent factor systems identified in the Greater system of uptake of e conferencing technologies is collaborative culture, seconded by the relationship between users and technology. Funding and barriers to collaboration hold the third and fourth place in impact value.

The report concludes that the implementation of innovation is a complex process involving numerous interrelating factors and that these should be addressed as systems and subsystems of factors rather than be approached as isolated variables affecting the process.
The project suggests that for e-conferencing technologies to be successfully implemented a whole systems approach is needed. However, to enable decision makers a realistic way of addressing the system as a whole the project introduces a new approach which prioritises rather than isolates factors.

The findings in this project exposed the complexity of the uptake process as embedded in issues relating to collaboration, collaborative culture, and organisational awareness and understating of what is entailed in translating 'green' remote collaborative desires to actual practices. The report suggests that for successful uptake there is a need for taking into consideration users' perceptions of the remote collaborative technology, users' requirements and expectations of the technology and of the organisation within which they work.

The report argues that for uptake to be successful there is a need for bridging the gap between the rhetoric and practices currently at play in the e conferencing for sustainable practices arena. The report argues that to bridge the gap there is a need for a shift in the way we address uptake. The report suggests using systems approach which enables to identify how various aspects of the process are linked. It is argued that understanding the links facilitates following the uptake process as an emergent phenomenon where the 'whole' is something greater than the sum, but at the same time reveals the points through which the 'whole' is assembled. These can be used as intervention points for facilitating successful uptake.

The report concludes that the implementation of innovation is a complex process involving numerous interrelating factors and that these should be addressed as systems and subsystems of factors rather than be approached as isolated variables affecting the process.

The report argues that problem lies in the basic perceptions underlying current implementation approaches and argues that there is a need for a new model of thinking. The paper proposes a model based on Systems Thinking. It addresses technical and non technical factors and clusters them into subsystems which comprise the greater system constructing the

process as a whole. The model enables to administer the implementation process in manageable yet interconnected segments of a multi factor system.

The project acknowledges the strategic problems of implementing uptake from within a system's approach framework. To enable decision makers a realistic way of addressing the system as a whole the project introduces a new approach which prioritises rather than isolates factors. The most prominent factor systems identified in the Greater system of uptake of e conferencing technologies is collaborative culture, seconded by the relationship between users and technology. Funding and barriers to collaboration hold the third and fourth place in impact value.

The project proposes a *'relational prioritisation'* in which prioritisation is decided according to the levels of connectivity of individual factors within their subsystems, and indicated levels of connectivity of subsystems within the whole. It is argued that highly connected parts should be prioritised over lower connected ones.

The approach proposed in this project enables addressing various parts of the system entailed in the implementation process while acknowledging the connectedness of the parts to the whole. This is enabled using concepts adopted from Social Network Analysis (SNA), and illustrated using Graph Theory techniques.

Recommendations

Organisations need to treat the implementation of e conferencing for reducing travel as a complex system comprised of multiple subsystems which have to be woven into the existing organisational and contextual systems.

Decision makers should approach the implementation of e-conferencing tools for reducing travel as a double tiered problem:
Tier 1 - Analysis

- Identify what factors are entailed in the process as a whole
- Identify what constitute each factor, and map the relationships between the various aspects comprising the factor to reveal a factor system
- Identify the impact value of various factor systems in the Greater system based on the factor system's prominence and centrality

Tier 2 – Implementation

- Use the information obtained in tier 1 to approach the implementation of e conferencing process as a complex system and address all the factors involved in a manner which will reflect their interrelatedness in the system as a whole. Manage the process by prioritising factor systems according to their position in the Greater system
- Use the view enabled by the analysis tier to identify points of intervention in the implementation process

The project proposes that parts of the analysis tier would be automated to enable efficient ways of producing analysis reports for the support of informed decision making and intervention strategies for the implementation tier.

The approach proposed in this project can be applied as a generic model to be used in various innovation implementation processes particularly in the area of technology or sustainability related practices as these pose large numbers of interrelating factors.

Full report

Sustainable Collaborative Research Activities:

A System's Approach to the implementation of e- Conferencing for Lower Carbon Footprint

Abstract

The growing need for environmentally sustainable remote collaborative research is often addressed using the '*if you build it thy will come'* model, where the provision of e conferencing technology is believed to instigate changes in practices and the replacement of face- to- face meetings with virtual ones. More comprehensive approaches where non technical variables were addressed tended to follow a binary trend which classified variables as *drivers and barriers.* The report challenges these approaches arguing that there is a need to break away from any binary models, and that processes of adopting technology should be viewed as *complex systems* comprised of interdependent relationships between various factors.

The report describes the findings of a one year project which set out to identify the technical and non technical variables entailed in the process of uptake, and chart the routes through which they interrelate. Emerging from this work is a System's approach based analysis of uptake processes where variables entailed are perceived as participants in subsystems within a greater system embracing the process as a whole.

Acknowledging the strategic difficulties entailed in implementing such an approach, the report proposes a new method which enables decision makers attempting to implement e-conferencing tools to prioritise clusters of factors aggregated into subsystems. The prioritisation of subsystems is achieved through the adoption of concepts from Social Network Analysis (SNA), and illustrated using Graph Theory techniques.
The method enables to administer the implementation process in manageable yet interconnected parts of a multi factor system.

The report concludes that the method described here can serve as a generic model for the implementation of diverse innovations and the introduction of changes to practice and culture they prompt.

Introduction

In their article "Crisis" Von Drehle and Scherer note that the New Deal initiative proposed by president Franklin Roosevelt passed only after he convinced the Americans that he had his priorities straight(Von Drehle & Scherer, 2009.p17). President Obama is said to be trying to work on 'all fronts at once' because as press secretary Robert Gibbs described it:

> *" the whole American house is on fire not just the particular room where the flames happen to be roaring, are you going to call the fire department and ask them to put all of it out? Gibbs asked. "Or are you going to say 'you know what" we love the living room, Start over there. And if you can, get quickly to the kitchen, and next to*

the den. We could do that and maybe by the time they get to the kitchen or the den the whole house is in ashes"(p.17)

Obama wants his team to multitask and address America as a whole rather than deal with parts of it. The president sees this approach as the key to making a difference. But people are concerned that the *whole* is too much and that the president needs to "Have his priorities straight". The problem facing the Obama administration is how to deal with the *whole* while at the same time address the various parts. I argue that this is a dilemma facing all decision makers in every type of organisation.

In this study I suggest that what is needed is a method that will enable decision makers to prioritise rather than segregate parts from within the whole. The report describes the development of a method which enables prioritisation and is demonstrated using data from a case study in which uptake of collaborative tools for conducting remote collaborative research was investigated. The data of the case study was analysed with the aim to discover the relationships between the various participating entities entailed in the uptake process, and their aggregation into subsystems and consequently a greater system comprising the process as a whole.

The method demonstrated builds on System Theory, Social Network Analysis, and Graph Theory. Its uniqueness lies in the manner in which it represents data to facilitate the identification of relationships, the construction of systems and the prioritisation of subsystems through measurements of their prominence in the greater system comprising the process of uptake as a whole.

The report is part of postdoctoral work which set out to find a method to contribute to our understanding of what is entailed in processes of uptake of e -conferencing technology, and what will enable their success.

The report presents a summary and analysis of the data collected via an international survey of researchers based at various parts of the world, and supplemented by information collected through 14 interviews. The report provides a preliminary mapping of the stakeholders, and variables involved in the processes of uptake of e-Conferencing technologies, and analyses them using the innovative method developed in the project.

Case study Research Problem

The benefits of saving time, money, and reducing carbon footprint entailed in using e-collaborative technologies for remote research has been appreciated by individuals, industry, universities, and governments(Thorns, et al., 2009). Organisations and individuals express wishes to utilise the technology for establishing sustainable research practices where increased use of e-collaborative technologies leads to reduced travel (Thorns, et al., 2008; Thorns, et al., 2009).

Transferring these aspirations to practise has often been addressed using the '*if you build it thy will come'* model, where the provision of e conferencing technology is believed to instigate changes in practices and the replacement of face- to- face meetings with virtual ones. More comprehensive approaches where non technical variables were addressed tended to follow a binary trend which classified variables as *drivers and barriers (*Markard & Truffer, 2008; Parente & Prescott, 1994; Strewart & Mohamed, 2004*).*

The lower than anticipated uptake of e- conferencing technologies depicted in literature, (Allan & Thorns, 2008, 2009; Frost & Sullivan., 2005; Hirsh, et al., 2005; Sankar, 2006; Vilaboy, 2007) raises questions as to the effectiveness of the approaches applied so far.

The project suggests that to understand why e-conferencing is not widely adopted by researchers, we need to investigate whole systems of variables affecting the choices researchers make, and the practices these choices generate. Previous work I conducted examined these notions through Social Constructivist and Bourdieuean lenses(Allan & Thorns, 2008, 2009) and enabled a view of technology not as an autonomous, but rather a complex enterprise that takes place in specific contexts shaped by and in turn shaping human values(Ellul, 1964). The project further develops this notion and proposes a Systems' Approach to the issue of encouraging diffusion of innovation and implementing change in practices.

The work argued that approaching the study of uptake from a systems framework will enable the unpacking of these complex processes in a non binary way in which a problem was addressed with a solution often resulting in unsatisfactory results. The systems approach proposed here will enable decision makers to effectively ascertain the importance of different factors while not losing site of the system as a whole, and identify which relationships between various factors are supporting the process and to what level of effectiveness (Allan & Thorns, 2009)

Purpose and aim

The report proposes a break away from binary based approaches, and argues that processes of adopting technology should be viewed as *complex systems* comprised of interdependent relationships between various factors. The report argues that attempting to isolate factors leads not only to a limited but at times misleading view of what is driving the uptake and what is contributing to its effectiveness, hence hindering the ability to identify the most effective actions needed to be taken in order to facilitate effective implementation. The report acknowledges that to enable effective implementation using a system based approach where multiple interrelating facets need to be addressed simultaneously poses strategic difficulties for organisations. To address these difficulties the report proposes a method which enables to prioritise rather than segregate parts of the process and address them as subsystems within the greater system encompassing the process as a whole.

Goals

To provide a way of looking at uptake processes as complex systems rather than binary aggregates where isolated variables are seen as either needing to be facilitated or resolved in order for uptake to be successful, and serve the context in which uptake it is expected to operate.

Provide a framework which allows the study of the uptake of e conferencing technology in the context it is embedded. Today's knowledge economy/society requires transnational research links but at the same time operates in a society concerned with an environmental crisis, and demanding 'green' practices. This context produced popular assertions claiming that:

I. The knowledge economy requires researchers to work collaboratively across geographical and disciplinary distances
II. Carbon footprint could be reduced through the use of e-conferencing technologies. Face to face (F2F) meetings could be complimented or at times replaced by virtual ones, hence reducing the need for travel and consequently the carbon emissions associated with it while at the same time maintaining high connectivity between collaborators
III. Prevalent and available e-conferencing technologies will lead to wide use and encourage change in practices

Building on of System Theory provides a view of the ways in which these assertions are played out in the perceptions and practices of the research community and how they construct the uptake of e conferencing technologies Resulting in the reduction of travel for collaborating with geographically dispersed teams.

Provide a breakdown of the uptake process exposing the perceptions about the need for collaboration, the ways in which the need is expressed, what practices and technologies are used for addressing it, and whether practices are guided or driven by environmental concerns about carbon footprint.

Theoretical Framework

The report breaks away from binary models and adopts notions of Systems' Thinking. Using System Theory approach provides a view of e- conferencing as assembled from numerous technological aspects, the use of the technology by people as creating human machine relations. Both technology and human machine aspects are embedded in interrelating financial economic social and political issues, all of which are operating as complex networks creating Systems(Bertalanffy, 1971).Applying Systems approach is particularly useful in cases like the one studied here, where the mechanistic scheme of isolable causal trains and separated treatment proved insufficient to deal with the problem. Systems' approach enables a change in basic categories of thought and the study of systems as organised and interrelated entities rather than conglomerates of parts (Bertalanffy, 1971). Juarrero & Rubino (2008) emphasise the importance of the relationships and interrelatedness between parts, and support Bertalanffy's argument that without interactions a collective is a mere aggregate. Juarrero & Rubino(ibid) emphasise that the presence of interactions facilitates the *emergence phenomenon* where the 'whole' reveals something different to the sum of its parts. Miller & Page(2007) further support this notion and argue that individual, localised behaviour aggregates into global behaviour that is in some sense different from its origins. To illustrate the *emergence* phenomenon Miller & Page compare it to pixels of a picture. One cannot see the picture by scanning the pixels at close range. When we step back the emergence is revealed, something emerges that was not there before, and the picture in its wholeness is revealed.

The concept of *emergence* can be approach from many perspectives; however, in the context of this study I will focus two of its principles:

1. The whole is different than the sum of its components (Juarrero & Rubino, 2008)
2. Reasonable changes to the individual parts do not change the whole (Miller & Page, 2007)

This study begins by identifying the parts, the pixels making the whole picture, in this case, the process of uptake of e-conferencing technologies for reducing travel. Once the whole

picture is assembled, the study proposes to introduce change through adjustments to the parts, so as not to disturb the bigger picture, in this case the organisation within which the uptake process is to take place. The level of adjustment introduced to parts of the uptake system will enable the emergence of a difference, adding something that did not exist in the individual parts but is emerging in the system as a whole, in this case, the wider use of e-conferencing. The ability to maintain stability while introducing change, is a System's Theory characteristic which incorporates equally maintenance and change (Bertalanffy, 1971).

Methodology

The report presents the findings of an online survey and fourteen semi structured interviews. SurveyMonkey.com. system was used for administering the online survey. Dissemination was done via email lists. To comply with current emailing laws prohibiting the dissemination of unsolicited email, a request for dissemination was sent out to email lists' administrators. In addition, a "snow balling" effect was activated by sending requests to colleagues inviting them to participate in the survey and forward the invitation to their colleagues. The result was a wide dissemination of the survey across various regions in the world. However, although the Web based survey is an effective tool in terms of speed and breadth of dissemination, the response levels are often lower than those achieved through other media (Cook, Heath, & Thompson, 2000).

The choice of emailing lists to which the survey questionnaire was posted was in accordance with the criteria chosen for the project.

Criteria for choosing the population of study

The uptake of technology is a complex issue, to reflect that complexity the choice of the population for the study included members from three relating groups:

1. Those calling for environmentally friendly solutions to research needs;
2. Those who develop remote collaborative technologies;
3. Those who advocate the use of remote collaborative tools for enhancing collaborative research

Online invitations were sent to the administrators of 23 emailing lists representing the three criteria mentioned above. In addition, 87 colleagues listed on the author's personal mailing list were invited. Of the 23 administrators 6 cooperated and sent out invitations to their subscribers. A total of 123 responded to the survey.

In addition to the survey 14 semi to un- structured interviews were conducted. Interviewees were selected according to the same three criteria used in recruiting the survey population.

The survey was disseminated online in a manner facilitating *snow ball* effect. This resulted in a worldwide spread reaching researchers based in various parts of the globe. Figure 7 illustrates the geographic distribution of the respondents.

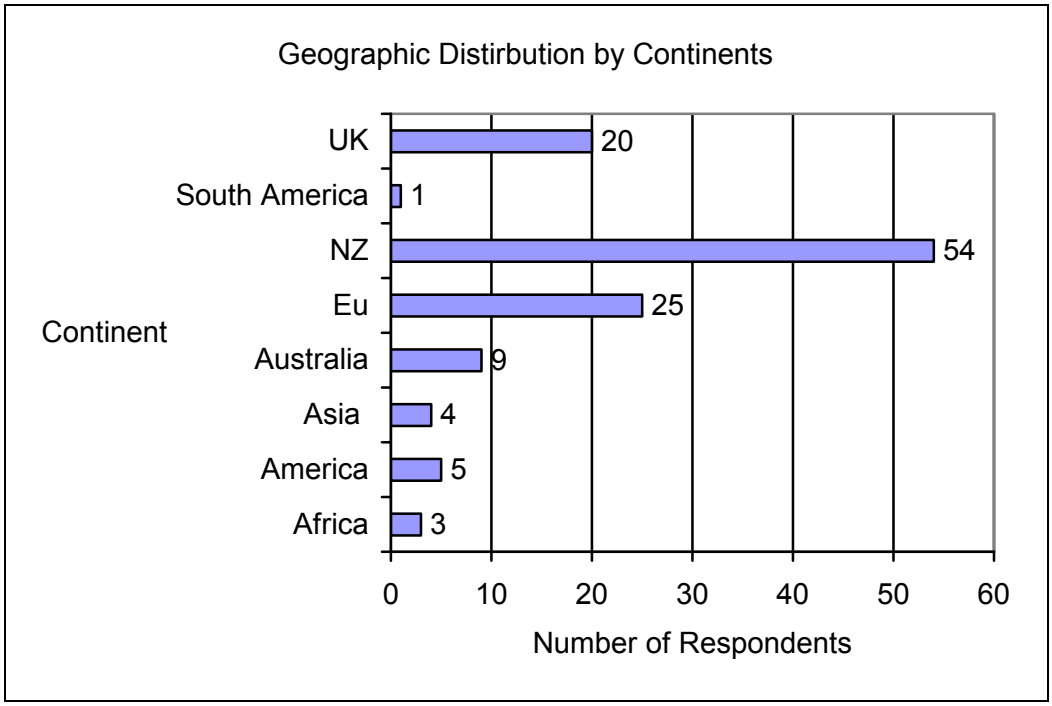


Figure 6: Geographic Distribution

The geographic distribution illustrated in figure 6 cannot be perceived as an objective indicator of interest in the topic of this study, it is a mere indication of the effectiveness of the networks through which the survey snow balled. The highest response rate came from NZ, the location of the researcher and hence most probably the primary source of her networks and the strongest ties.

Who are the respondents?

To ascertain the nature of the population of the study, the survey asked respondents for some demographic information about themselves alongside some information about aspects relating to their work.

Personal demographics

Age:

Figure 7 illustrates the age breakdown of the population of the survey**.**

1. Age

	Response Percent	Response Count
19-29	9.8%	12
30-39	27.6%	34
40-49	36.6%	45
50-59	17.9%	22
60+	8.1%	10
answered question		123
skipped question		2

Figure 7: Age N=123

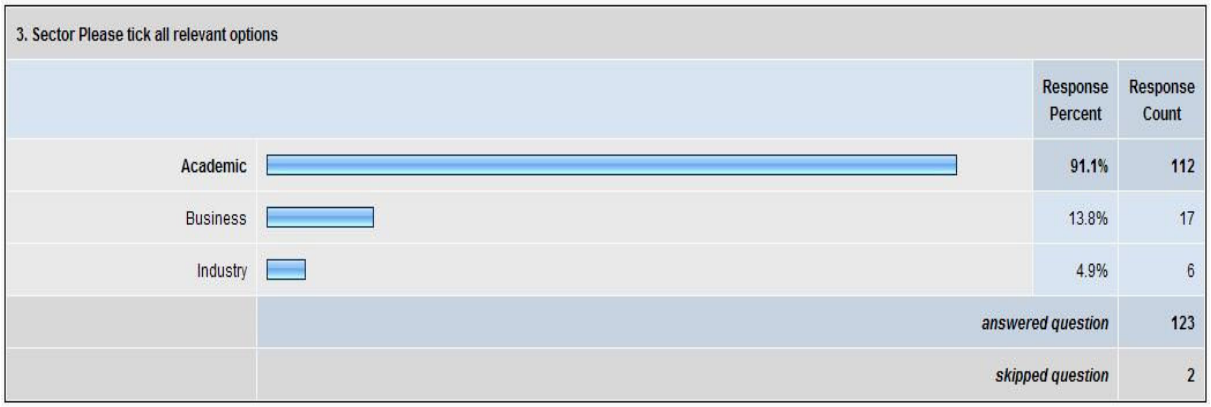
Figure 7 shows that the largest age group (36.6%) was that of respondents aged between 40 and 49. The second largest group was the 30-39 years old (27.6%).

Gender:

58.5% of the respondents were males
41.5% females.

Work aspects

Sector:
The survey asked respondents to identify their work context along three sectors: academic, business, and industry. Figure 8 illustrates the percentage of respondents in each sector.



3. Sector Please tick all relevant options

	Response Percent	Response Count
Academic	91.1%	112
Business	13.8%	17
Industry	4.9%	6
answered question		123
skipped question		2

Figure 8: Sector N=123

Figure 8 shows that most of the respondents work in academia (91%).

Discipline

The survey asked respondents to define the discipline in which they work. Figure 9 illustrates the various disciplines noted.

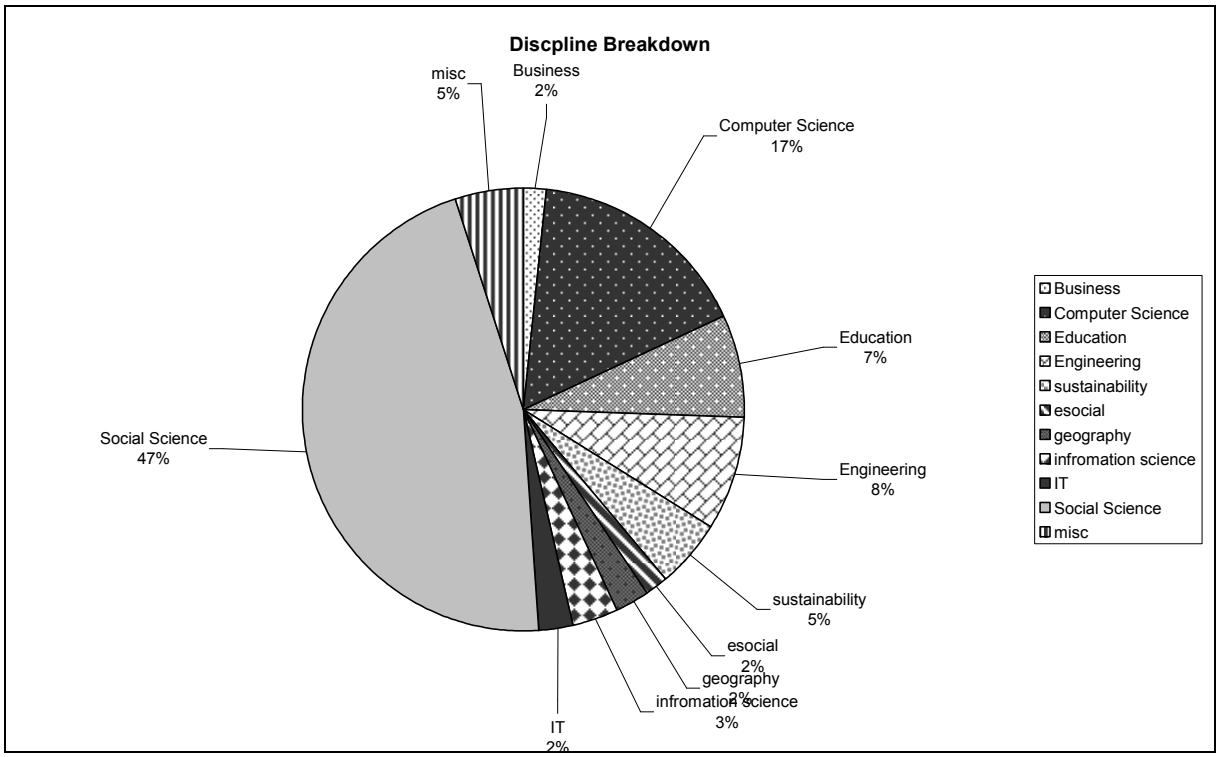


Figure 9: Disciplines – N=123

'Figure 9 shows that almost half of the respondents- (47%) are social scientists. This may indicate that social scientists are those most interested in the topic of the survey. However, the high percentage of social scientists may simply reflect the disciplinary structure of the author's contact network.

Role

The survey asked respondents to describe their role in the workplace. The largest group (35.8%) identified themselves as researchers. The second largest group (29.3%) defined their role as associate professors, professors, lecturers, or academics.

The survey questions addressed three operational **statuses** of factors relating to the use of e-conferencing technologies:

2. *Perception status*- Identified through survey questions in which participants were asked to: explain their choice of technology, describe notions associated with use of technology for collaborative remote research, and convey feelings, opinions, and expectations
3. *Practices status* - Identified in survey questions where participants were asked to Choose activity, or tool, or alternatively note availability of a technology, a norm, or a practice
4. *Expressions status*- Identified in survey questions where participants described situations in the work place

Survey questions provided quantitative and qualitative data. The quantitative data is presented in graphs representing:

- Access to technology,
- Familiarity with e conferencing technologies,
- Perceptions of effectiveness of technologies,
- Choice of technologies

- Choice of platform for participation in conferences

The analysis of the qualitative data led to the identification of the various factors underpinning the aspects depicted in the quantitative graphs.

The findings of the qualitative data are organised in a manner which highlights their interrelatedness, and consequently the identification of factors as members of systems. The organisation of the factors in this way laid the foundations for the development of a new method of analysing uptake processes.

The method used for organising the factors facilitated their presentation not as individual entities but rather as systems of factors. The method provides a non binary perspective of the process of uptake, and enables a multi level view of the process as emerging from within the relationships of factors within their systems as well as through the relationships between the various *factor systems* creating the process as a whole.

The method demonstrated here dissects systems comprising processes of uptake and offers a clearer view of what is entailed in the *emergence* (Miller & Page, 2007) of such processes as wholes, and contributes to our understanding of how systems comprising processes are created through the various interrelating parts

The ability to follow the emergence as created through these different levels of systems allows for disassembly of the whole at different points (Miller & Page, 2007). This ability facilitates informed intervention for successful implementation of e conferencing technologies. However, it also poses strategic difficulties in addressing multiple factors embedded in one or more systems of factors all at once. To address these difficulties the method identifies the impact value of the various *factor systems* hence creating a prioritisation mechanism. This mechanism allows decision makers to design different phases in an implementation plan based on the priority levels of factor systems. Priority levels are established in accordance with the level of prominence a factor system displays within the Greater system. The prioritisation strategy facilitates a localised yet interlinked approach and provides a systemic approach to the implementation of e- conferencing. Furthermore, it proposes a *'relational prioritisation'* in which prioritisation is decided according to the levels of connectivity of parts within the whole, and highly connected parts are prioritised over lower connected ones. The prioritisation of factors is obtained through the adoption of concepts found in Social Network Analysis' Centrality and Cohesion routines, and is illustrated using Graph theory.

Findings

This section presents the findings of the survey and the interviews conducted. It then goes on to demonstrate how the organisation of these findings is used to form the new method described in the methodology section.

Survey findings

The primary goal of the survey was to identify and map the various variables affecting uptake of e-conferencing technologies as a process embedded in the context of today's knowledge economy/society, which requires environmentally friendly transnational collaborative research. Working within this context the survey set out to investigate what are respondents'

perceptions of collaboration, how need for collaboration is expressed and how use and practices are applied in order to address the need to collaborate. The next section describes the respondents' perceptions of collaboration

Perceptions of Collaboration

This section looks at the way people perceive the notion of collaboration.

96.6% of the respondents perceive collaboration as an "exchange of information and sharing of ideas with other colleagues".

Next the survey enquired if people enjoy collaborating, why and in what ways.

The majority of the respondents said that they enjoy collaboration and as one respondent expressed:
"People have collaborated for centuries, of course they enjoy it. We're wired to enjoy collaboration. Otherwise we would be dead".

Respondents commented about the diversity enabled through collaboration, and pointed out that it is more efficient as it opens up more opportunities, and it is stimulating commenting that they:

"Enjoy people diversity".
"… enjoy collaborating because it is a much more efficient way to generate effective social research. It is also very stimulating".
"*Get more done by collaborating, often*".
*"….. it is **stimulating**. Allows access to ideas and skills I don't have myself. Brings robustness to projects. Also attracts funding often as benefits are spread more widely so the projects are seen as more valuable".*
"*….. widens horizons and keeps life interesting"*
"….. like working with people with similar interests".

Is there a need for collaboration?

This section presents respondents' views about the notion of the need for collaboration, how it is expressed and what do people do in order to meet the need.

To ascertain the presence of need, respondents were asked if they think their work requires collaboration.
92.3% said it does, and noted that:

"Now almost every work is multidisciplinary and requires collaboration".

"To be creative and innovative as a researcher needs interdisciplinary exchange and sharing of ideas; Collaboration allows seeing a problem from different perspectives".
"I don't feel the quality of my work would be as good without others' input. Support".

To further focus the quest for 'need' the survey asked respondents if collaboration is important in their line or work.
One respondent stated that "*Science is teamwork".*

Others said that collaboration is important to their work because of its complex nature, or it inter-disciplinarity.

> *"….. essential to our current work. The research and education problems we are dealing with can only be tackled well through collaboration".*
> *"its interdisciplinary".*

Some alluded to funding related issues:

> *"Research funding models advocate collaboration, and wish to see evidence of it".*
> *"It will be - academics working alone would have a hard time getting funding"*

A number of respondents expressed some ambivalence saying that:

> *"It[collaboration] is the buzz word these days in every thing. In my view, good collaboration can be very good, doing it for compliance is waste of time".*

Respondents were asked how they feel about collaborating within their institutions and describe the key aspects affecting their views. 31(42.4%) out of the 73 responses to this question were positive about collaboration suggesting that:

"[Collaboration is] essential so we're not 're-inventing the wheel"
"Essential to my research. Science is teamwork".
"……..I enjoy it"

"*Standard practice - necessary"*

"Collaboration is essential to obtain large research grants and to meet demands for end-user driven research. There are also great opportunities for stretching the boundaries of social research through collaboration. The BRCSS initiative has done a great deal to assist social scientists interested in collaboration to further their research interests".

> *"Necessary to advance understandings and practices of complex issues and problems"*
>
> *"It's mandatory"*
>
> *"Builds better working relationships and information flow, spreads knowledge and skill"*
>
> *"Information exchange is absolutely critical and directly related to the organization's ability to move forward and stay competitive in the market"*
>
> *"Collaboration helps move ideas forward faster regardless of whether it is internal collaboration or external collaboration. When people refuse to share ideas it is counter productive".*

These excerpts highlight the necessity for collaboration for ensuring "good science", advance understandings, obtain research grants; ensure information flow necessary for productivity.

Counter arguments claimed that:

"Collaboration is not given a high importance"

> *"....careers are individualistic constructs .....i advise my new staff to be careful about running into collaborations. Only do it if it is of genuine benefit to them. Collaboration is mainly an anodyne concept, not necessarily of much worth. It depends on the conditions on the ground / in which the researcher is located. Insofar as successes are measured in terms of published outputs and collaboration involves a division of research outputs, it is to be avoided. Philosophers (i am not a philosopher) scored so well in the 2003 and 2006 PBRF in part because they do not have to undertake collaboration... the talking up of collaboration is the result of a policy infatuation with a version of the hard science model of research - one that is centred on machines that go 'bing'".*

The counter arguments list problems that have to do with the ways in which academic careers are constructed and measured, and about its different levels of effectiveness across different models of epistemology.
Some respondents were ambivalent in their perception of collaboration arguing that:

"It is productive if the people and the project one is working with are interesting, stimulating. Otherwise, it is a lot of organizing time wasted for little results".

"Good. But projects with too many collaborators lose pace and often drift. It is difficult to repel freeloaders once they have become engrained with group. There is enormous variability as to how hard people will work in "collaborations"!
"

"Necessary, often highly worth while, often very time consuming and can be frustrating".

"I think it is of fundamental importance in building a learning community - especially in a merged institution like ours - but I recognise that I am working on a cultural change which is not necessarily identified as priority within the institution as a whole. It is valued, and/but - it is not necessarily seen as a step toward getting greater effectiveness as we strive to build knowledge around teacher education. At UC, the silos of the Colleges limit our making really good use of shared expertise or building communities between groups that have different funding".

The survey asked respondents about collaboration beyond their own institutions. A number of respondents did not differentiate between collaborating within the institutions and going beyond. However, some expressed differences for and against. The positive remarks suggested the following:

> *"Enjoy the break from routine, improves productivity, and innovation in thinking, extends workplace and research possibilities"*
>
> *"Great opportunities if one is willing to move outside the constraints of institutional competition for status and funds".*
>
> *"Outside my institution I have more choice and usually collaborate with people I want to"*
> *"Useful for maintaining ties with former colleagues with specific expertise".*

The opposing remarks stated that:

"Its tough to arrange"

"Hard work to actually get something going and at the same time with funding..."
"Interuniversity collaboration can be tricky because of technical resourcing (e.g funds to support acquisition of, training for, maintenance of and access to) tele technologies that: are available on demand, work all the time, do not come out of your own research budgets. It is embarrassing to be engaged with a more sophisticated institution".

"Different cultures sometimes cause difficulties for the collaboration".

Some were positive in principal but expressed reservations:

"Happy to when the tools are in place and expectations are clear".
I would love to but hard to find people"

The survey asked respondents to describe their expectations of an e-conferencing meeting 28% claimed that they resemble face-to-face meetings; however, 34% said they were dissimilar to face to face. Explanations to these expectations were as follows:

"Dissimilar, because you can't share items (non electronic documents, equipment, etc)"

"Dissimilar due to discomfort of technology – especially restricting movement. Also lack of sense of "presence" in the metaphysical sense".

"Face to face and why: I can see the people and hear them - usually quite well. I attend to them carefully. There are delays in responses and not the same atmosphere as face to face but I have a pretty good imagination!"

The issues outlined here refer to the perceptions surrounding collaboration and highlight aspects relating to the nature of the work becoming more complex and interdisciplinary. It also refers to institutional aspects of the way funding is allocated. Another point mentioned is the emergence of collaboration as a "buzzword" and sometimes applied by policy makers and embedded in policies which literature suggests is leading to the necessity of compliance (Michael Loughlin, 2002).

The survey asked respondents what in their opinion is needed for successful collaboration. Figure 10 illustrates the responses.

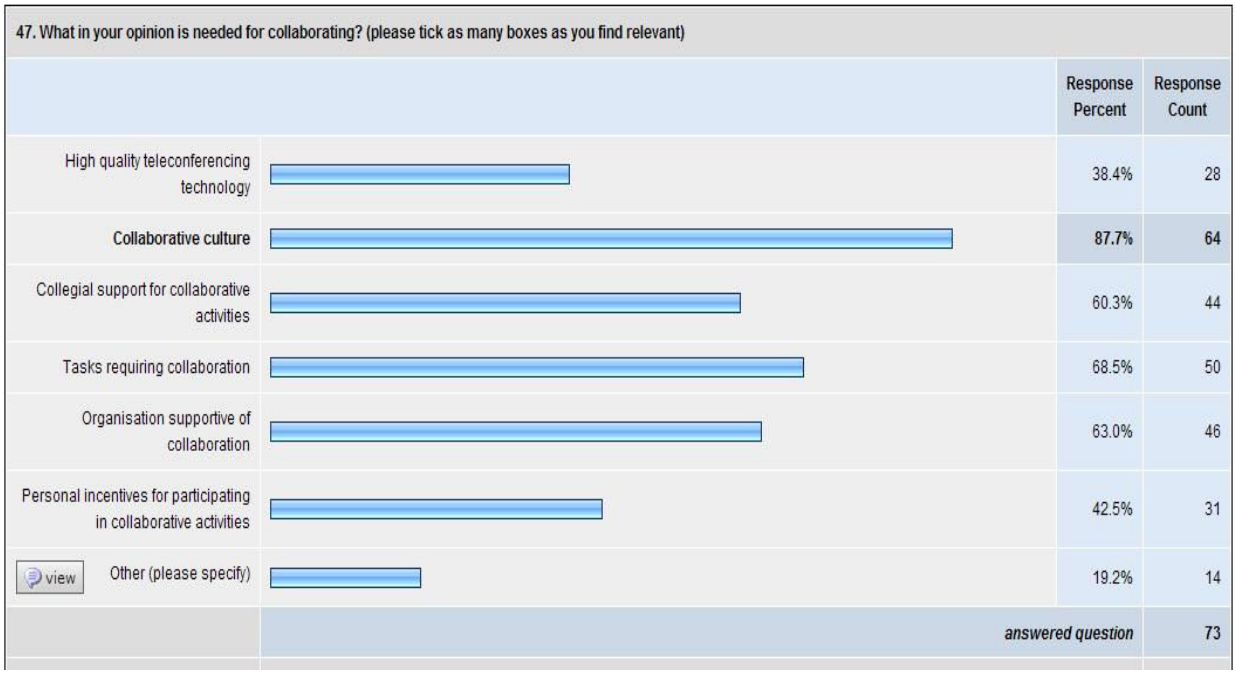


Figure 10: Collaboration needs- N=73

Figure 10 shows that the highest rating was given to 'collaborative culture' (87.7%). Other factors such as 'task requiring collaboration were rated by 68.5%, close behind at 63% was the 'organisational support of collaboration', and collegial support for collaborative activities were rated by 60.3%.

14 respondents out of the 73 chose the 'other' option adding issues like willingness, time, combination of factors, and clear benefits, technical support, lack of incentives:

> *" **willingness** to share ideas and interests; a respect for the strengths of others in the team; being prepared to put one's own ideas to one side if they clash with those of the other team members; a willingness to follow as well as to lead"*
>
> *"**Time** for negotiation of objectives, protocols, sharing of costs and benefits, and methods of work"*
>
> "*You need **some element of each of these**……"*
>
> *"Clear understanding of the wins for me"*
>
> *"Enough **technical support** to make the process non geeky"*
>
> *"There are currently quite strong **disincentives** - such as poor tech and poor recognition of the value and purpose"*

On the other hand one participant argued that:

> *"None of these are needed. Children collaborate on playgrounds everyday with none of these factors. We don't need grants or software for collaboration"*

To summarise these comments it is possible to see that some of them have to do with issues of collaborative culture i.e. willingness, incentives or the lack of them. Others could be associated with organisational support, i.e. time, technical support,

Expressions of the need for collaboration

This section looks at expressions of collaborative activities as they are manifested in the respondents' work context.

- 90% of the respondents said they are involved in collaborative tasks in their workplace

- 37% of the respondents stated that over 50% of their working week can be seen as being collaborative.
- 45% said they engage in collaborative activities everyday
- 61.6% of the respondent stated that they work in teams

To illustrate how need is expressed respondents indicated four key issues

1) Working across sites

> "*I work in a partnership with five institutions that are geographically distributed across the United States. We have to collaborate to survive*".
> *"I'm based in the UK and work with colleagues based all over Europe. Also work with colleagues based all over the UK".*

2) Working across disciplines

> *"I do interdisciplinary work involving computer scientists; sociologists, information scientists, etc- often based in a number of different institutions".*

3) Working in dispersed teams

> *"I work on a team of 200+ people across multiple time zones. We integrate hardware and software. Collaboration is required to manage requirements, design, development, integration, test, and fielding between our team and our customer.*

4) Working across expertise

> *"Work is cross discipline and therefore needs working with those in other areas of expertise - easiest if these people are accessible and easy to maintain contact - as yet experience has been those who you can work with physically as well as electronically works best".*

Another expression of how collaboration is expressed in the workplace is illustrated in figure 11, illustrating the distribution of collaborators as described by the respondents to the survey.

33. Who are your collaborators?						
	In all cases	In most cases	In some cases	Very rarely	Never	Response Count
Colleagues within my department/school/college /organisation	15.7% (11)	**38.6% (27)**	**38.6% (27)**	4.3% (3)	2.9% (2)	70
Colleagues from other departments/schools/college /organisation within my city/region	5.9% (4)	23.5% (16)	**47.1% (32)**	14.7% (10)	8.8% (6)	68
Colleagues from other departments/schools/college /organisation outside my city/region	4.2% (3)	16.9% (12)	**67.6% (48)**	7.0% (5)	4.2% (3)	71
Colleagues from other departments/schools/college /organisation outside my country	7.2% (5)	14.5% (10)	**52.2% (36)**	18.8% (13)	7.2% (5)	69
					Please add comments view	7
					answered question	**73**
					skipped question	**52**

Figure 11: Who are the Collaborators-N=73

Figure 11, provides an indication of physical distance of respondents from their collaborators. 38.6% of the respondents said that 'in most cases' they collaborate with people from within their own institution, which in most cases would indicate relatively short physical distance. 67.6% of the respondents said that in 'some cases' their collaborators are colleagues from other departments in the region, and 52.2% indicated that their collaborators are from outside the country.

45.2% of the respondent said that most of their collaborators work in locations other than their own. However, an almost similar number, 43.8% indicated that only 'a few' of their collaborators work on locations other than their own. The almost even opposite response illustrate some polarisation between groups and raises questions as to what causes this polarisation. Possible causes could lie in the realm of differences between discipline, research field, or institutional culture. Unfortunately these questions are beyond the scope of this report however they open up avenues for further research.

Use and practices applied for addressing the need to collaborate

This section looked at organisational factors affecting collaboration. Figure 12 illustrates what respondents said when asked if their organisation encourages collaboration.

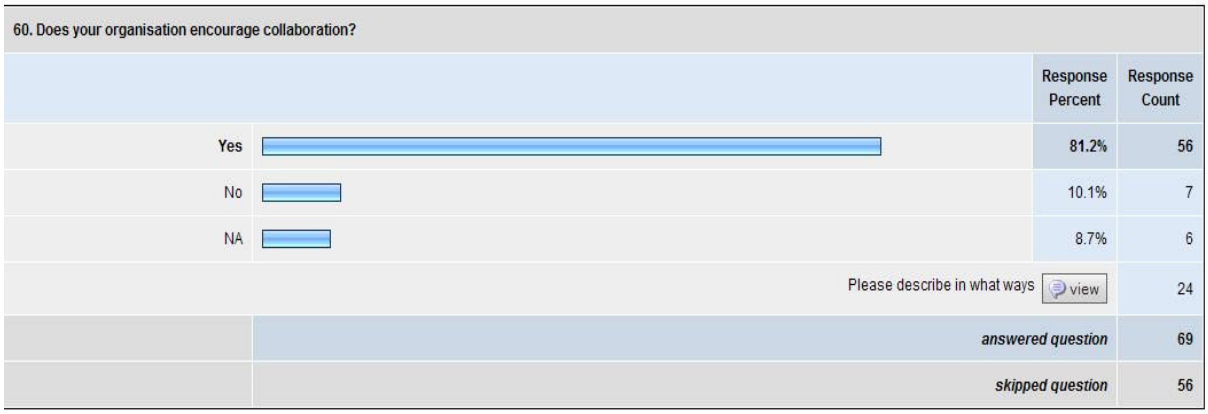


Figure 12: Encourage collaboration in organisation-N=69

Figure 12' shows that 81.2% of the respondents said that their organisation encourages collaboration. When asked to describe the ways in which encouragement took place, respondents portrayed the following:

Positive responses

"Urging people to work together communicate various meetings and with team based projects".

"My project requires collaboration and my organization provides the tools to support it".

Ambiguous

"Probably as it gives research grants and conference grants"

"Officially, but doesn't provide sufficient institutional and cross-institutional backing".

"It encourages collaboration in teaching and in administration and has a minimal sense of collaboration as a goal of research process. Has a strong notion of collaboration as a basis for unit, but does not really have a sense of what collaboration could /should mean in that context (or any other). There is no tangible reward for collaborative practices"

"It encourages collaboration to get the best teams for research and, in some cases, to reduce overlap between faculties in teaching programmes. But the funding model for Faculties does not necessarily make for a very conducive environment for collaboration"

"The nucleus does...the larger organisation does not".

"I belong to a cross organisation collaboration, the research group does by funding visits to other institutions, enabling video conferencing and seminars. The university itself doesn't".

Rhetoric versus practice

"Rhetorical - but not in any practical way"

"In theory only"

"No real incentives provided"

The survey asked respondents to describe how collaboration is initiated, organised, and applied in their workplace:

Initiated
"Individual initiatives on the whole"

"Someone knows someone, then we get together for a coffee."

"Individual decision to proceed"

"*By individuals - seldom by the institution"*

"Individuals make approaches to colleagues"

"Through researchers' individual/team efforts"

"It is left up to individuals in the main, although there are some organisational incentives for cutting-edge research".

Organised

"*Mainly team-based projects and also decision committees"*

"when chasing research funding"

"of course the university wants us to collaborate at every level, but there is no real encouragement for genuine collaboration given the management structure and financial accountability regime. So all the above questions feel quite difficult to answer. The answer will be yes but the meaning of collaboration is different than I understand it to be".

"By being in the same building"

"By fostering our attendance at conferences etc. and our involvement in research networks."

"not explicitly as in policy except through funding"

"Visiting fellows, calls for multi-institution research proposals"

"Initially a academic/research group is formed, then his members create a committee and decide how it going to work (rules, budget, communication, tasks, etc.). This organization is applied to create new academic/research projects".

"Encouraged through University events to find local people in other departments Local networking events non-University based"

"We have an internal web site that provides guidance on selecting and using collaboration tools/mechanisms. Otherwise, it's up to individuals to initiate collaboration, or team managers"

"It is not, to my knowledge, except on entirely informal basis".

"Projects, planning events, collaborative research, delivering training"

Applied

"Face-to-face meetings"

76.5% of the respondents said that no specific technologies were allocated to specific tasks

Aspects of organisational factors affecting collaboration were revealed when asking respondents if collaboration is important to their organisation. Respondents pointed out factors relating to the quality of outputs, and PBRF rating; the collaborative and multidisciplinary nature of the organisation, and issues of efficiency and benefits. The following quotes illustrate these points:

Outputs:

"Lots of interdependencies between departments and also externally in industry"

***"PBRF** ratings"*

"Improving research output"

Nature of the organisation:

"Our role is to bring people together and promote collaborative research. it is fundamental to our organisation".

*"**Multidisciplinarity** is required for many research topics and problems. Multi funders involved in significant pieces of research Multi research organisations required to collaborate as above, to obtain funding".*

"We're a globally distributed organisation".

Efficiency and benefits

"The institution wants to reduce the number of courses taught and increase class sizes (this requires collaboration amongst the teaching staff to ensure adequate content is included in courses) and to increase the volume of external research funding, which requires collaboration to develop effective bids".

"Learn from other organizations".

Other responses pointed out some problematic and conflicting issues:

*"The basic science model has lab cooperation but sit in offices for all else. **The physical fabric of the U is usually not conducive cross-discipline or cross-team engagement**"*

*"Because of **funding,** collaboration is said to be important in the organisation - however, **the competitive model** (vis-a-vis the 'brand') is still more important, so inter-institutional competition is not necessarily actively encouraged".*

".....not a key part of the discourse in universities in my experience except in large funded research projects - the discourse is mostly about some mythical autonomous research individual".

*"Possible although not that many **incentives/encouragement** to those who have taken this course".*

The survey asked if collaboration is seen beneficial among **colleagues in the organisation** The responses alluded to the following key issues: funding and other incentives; individual versus institutional support

Funding and other Incentives

"Not sure - probably only if it brings in money"

"For the purposes of securing funding but not for the benefit of the project!"

"But not rewarded or facilitated"

"Yes, because working in multidisciplinary workgroups we can see problems in different ways and our collaborations helps to all members to advance on research and academic subjects. All the members could be beneficed with projects, publications and experience on diverse fields".

Individual perception versus institutional agendas and support

"Networking and working together highly regarded. Company politics an issue however"

"Generally regarded as important although 30% are involved in little collaboration in their primary research agendas"

The survey asked if collaboration is seen as beneficial among **management in the organisation**.

Some respondents did not distinguish between the benefits of collaboration as seen by their colleagues, and those seen by management. However, others said that management sees benefits in engaging other stakeholders and attracts funding.

"The question for us is, do our stakeholders and partners see collaboration as important. It's a mixed bag - some do, some don't. Some have had bad experiences; others are inexperienced with collaboration. My view is that the skill level for collaboration is pretty low and that drives behaviours and attitudes".

"Primarily as a means for engaging others in the industry".

"Attracts funding. Encourages sharing of good practice".

"Increases prestige and hopefully funding"

"to guarantee successful joint project proposals and funding"

Respondents also pointed out that although management approves, there is a gap between rhetoric and practice, and collaboration needs to be better incentivised:

"In rhetoric but not resourced practice"

"Rhetoric is about this but often the practice does not seem to reflect collaborative - collegial forms of activity or decision making"

"Yes but needs to be better incentivised".

Some were sarcastic saying that:

"I don't know - they mainly want to keep money coming in!".

"In that collaboration with 'higher-status' academics allows us to improve our status. That's a cynical view of management's approach to collaboration, but in the university sector (in …. at least) I think it's accurate".

"There is an army of "collaboration scholars" who need research funding".

"*A bloomin' panacea. Collaboration has displaced interdisciplinarity as the new buzz word and rationale for restructuring among management types - who don't necessarily do research".*

"Anything that gets pbrf ratings higher"

Others pointed out the gap between institutional traits and collaborative practices

"....management are mainly from traditional university setting where individual publication is the measure of success - and they may not be as aware of the historically collaborative nature of the disciplines from which they come….."

"Perhaps - apparently - but you would think not from the ranked valorisation of pbrf scores".

"They don't do it that well"

Respondents were asked to identify the hurdles impeding collaboration. Figure 13 illustrates the responses.

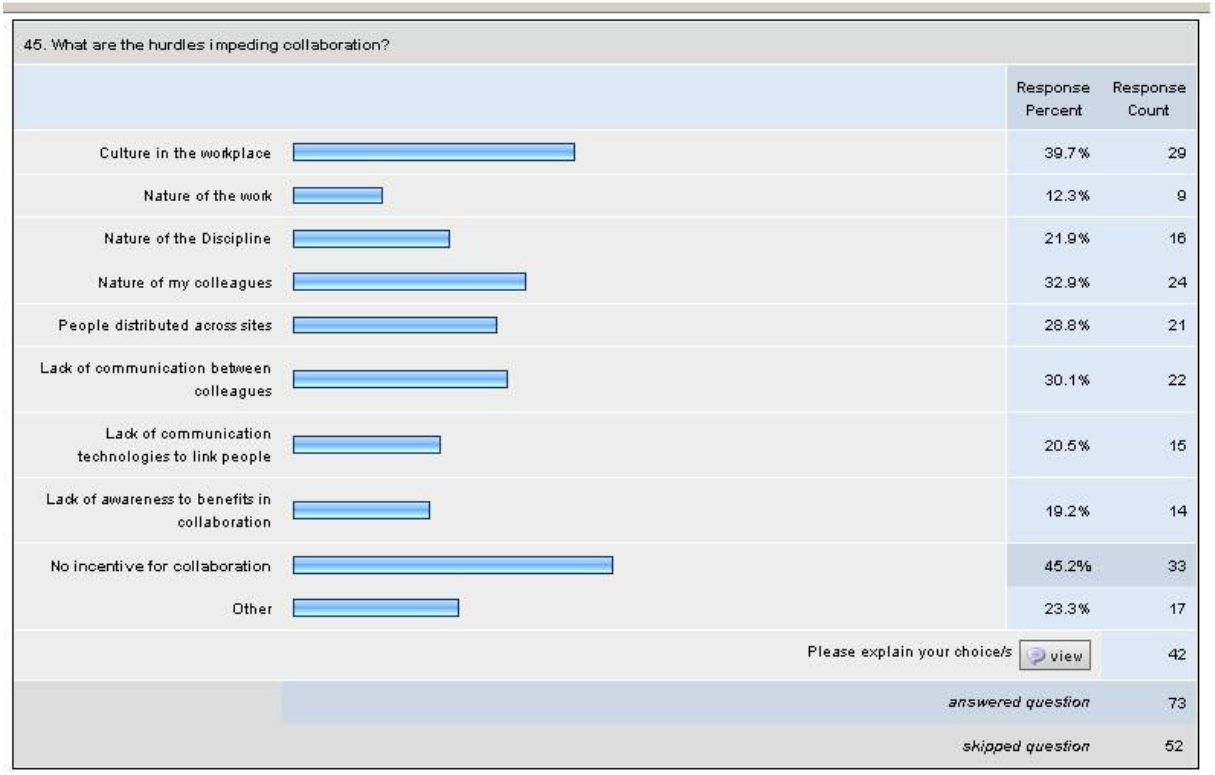


Figure 13: Hurdles for collaboration- N=73

Figure 13 shows that 45.2% , the highest percentage of responses, identified lack of incentive as a hurdle for collaboration. Culture in the workplace came second with 39.7%, and nature of colleagues was identified by 32.9% of the respondents.

Respondents were asked to explain their choice, and here is what they said:

Culture of workplace

> *"There is a strong emphasis on 'territorial protections' in the current accountability mentality in organisations. Collaboration is talked about but not encouraged or facilitated if money will get divided as a result of it".*
>
> *"For many collaboration requires a cultural change and a change in daily practices".*
>
> *"The managerial system has destroyed academic enthusiasm".*
>
> *"We are expected to collaborate but only within the department, there are no networks or links to other similar departments throughout the country and no knowledge of the individuals in those departments".*
>
> *"Workplace culture has to support it colleagues have to see it as a positive thing and not a threat of people stealing ideas or pbrf".*
>
> *"Hurdles are mainly institutional - trans disciplinary research is not accepted as useful or an important contribution. Projects are measured on the papers produced and their quality, interdisciplinary journals are*

few and far between and their citation indexes are lower than disciplinary journals".

"I think that the most important hurdle impeding collaboration could be the people distributed across sites. This condition inhibit face to face communication, therefore we depends of our remote messages. The quality on our communications affects directly in our team work".

"Collaboration's biggest hurdles are not longer technology, distances, or cost (many solutions to collaborate are freely available, relatively easy to use, and reliable); therefore, I selected hurdles that were centred around culture and personality as these are what appear to me as the items that now impede collaboration"

"There must be a cause for the collaboration. Cultural differences may affect to the openness and other aspects which affect the collaboration".

Nature of colleagues

"Limited by shallow networks and time"

"Sociology does not encourage collaboration as much as some other academic disciplines. Individual people have to work out how to collaborate on research projects, which isn't always easy because it involves personal and professional compromises".

"Some individuals do not see the benefits of info share. We have several field stations with people out on site, sometimes there is not enough time to communicate and collaborate".

The survey asked what makes collaborative activities successful. Some of the responses can be categorised according to the hurdles identified earlier in the survey:

"Organisation culture and people attitude".

"Incentive of people for collaboration"

"Incentives, a good general atmosphere; recognition of academic qualities".

"Good working relationships, supportive management and university infrastructure - IT / communications only a minor part of the success"

"Above all, if people meet their deadlines (and are not over-committed). Next, if they can handle the collaborative technologies (some don't know how to upload to a wiki!). Third, it the get the spirit and benefits of collaborative technologies".

"*Building trust/understanding being willing to be open to new ideas and challenges*"

"Nature of colleagues".

"Willingness to compromise, be open, flexible - usually very helpful to have at least one face to face meeting early in order to build relationships".

"Enthusiasm and common interests"

***"**Enthusiasm and competency"*

"Right people with helpful attitude"

"People with mutual respect and complementary knowledge working on something that they are passionate about".

"Open and honest approach, no ego's or "stealing" the limelight".

"Quality of the individuals involved, however, would be high on my list".
Others talked about the need for clear and shared aims:

"Being clear about aims and objectives I think, rather than just having a vague plan that "we could collaborate"

"Shared goals, shared focus on excellence, generosity of spirit".

"Structured approach to collaboration with well defined goals, roles, responsibilities, and expectations".

One person summarised it all by saying:
The ethos, the culture, the colleagues and the tools...in that order

How technology is used to address the need for collaboration?

The survey first asked if respondents think that collaboration can be successful using e-conferencing tools. Figure14 shows their responses

48. Can collaboration be successful using teleconferencing tools?

	Response Percent	Response Count
Yes	93.2%	68
No	6.8%	5
answered question		73
skipped question		52

Figure 14: Collaboration via technology -N=73

93.2% of the respondents thought it is possible to have successful collaboration using e-conferencing technologies.

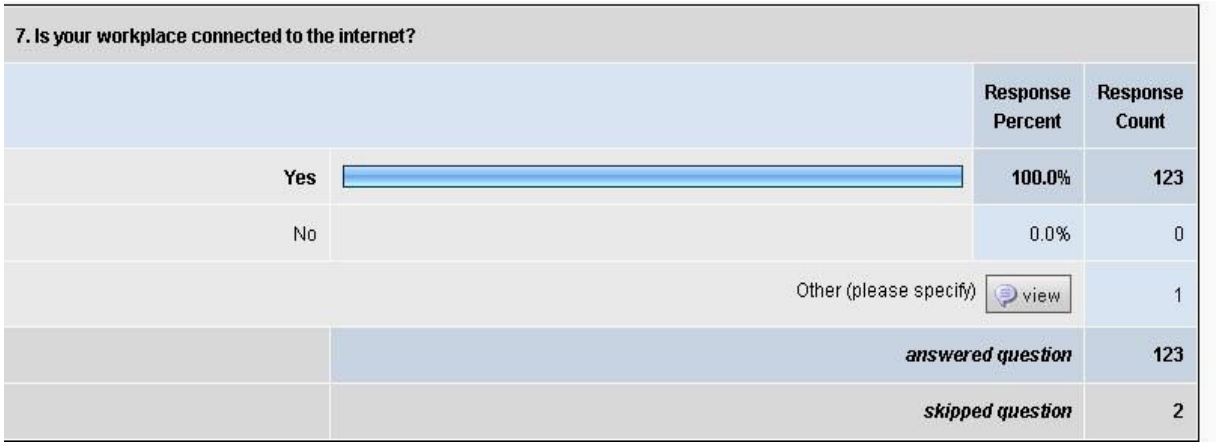
Respondents were asked about the ways in which technology is used to address the needs of collaboration. This section of the survey was constructed around four key areas:

1. Availability
2. Familiarity

3. Users and institutional perceptions and attitudes to technology
4. Use and practices

Availability

The survey looked at basic infrastructure issues, beginning with establishing the level of connectivity as a factor affecting the uptake of e-conferencing. Figure 15 illustrates levels of connectivity to the internet in the workplace.

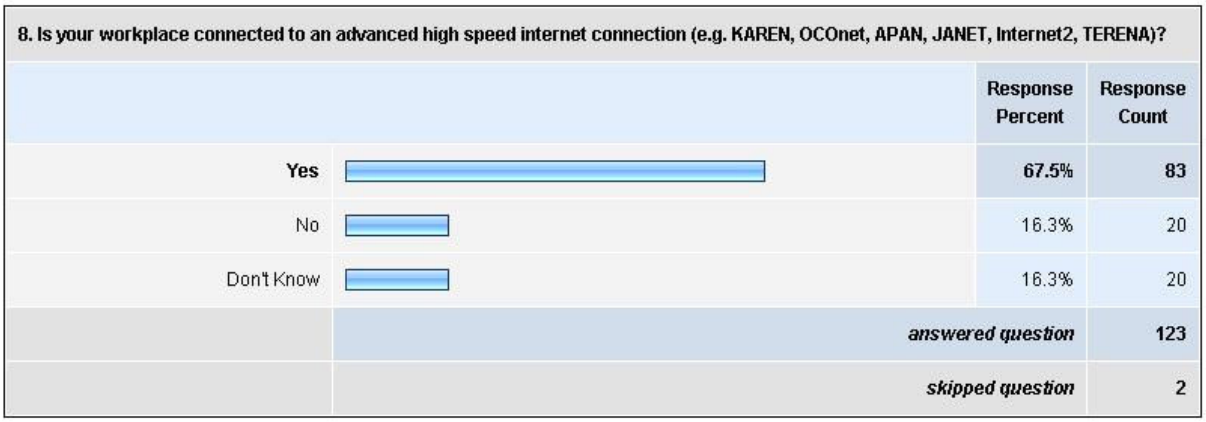


7. Is your workplace connected to the internet?	Response Percent	Response Count
Yes	100.0%	123
No	0.0%	0
Other (please specify) view		1
answered question		123
skipped question		2

Figure 15: Availability to the internet- N=123

Figure 15 shows a100% have access to the internet in the workplace.

A more specific level of inquiry of connectivity asked respondents about Availability to the high speed research network. Figure 16 illustrates this aspect.

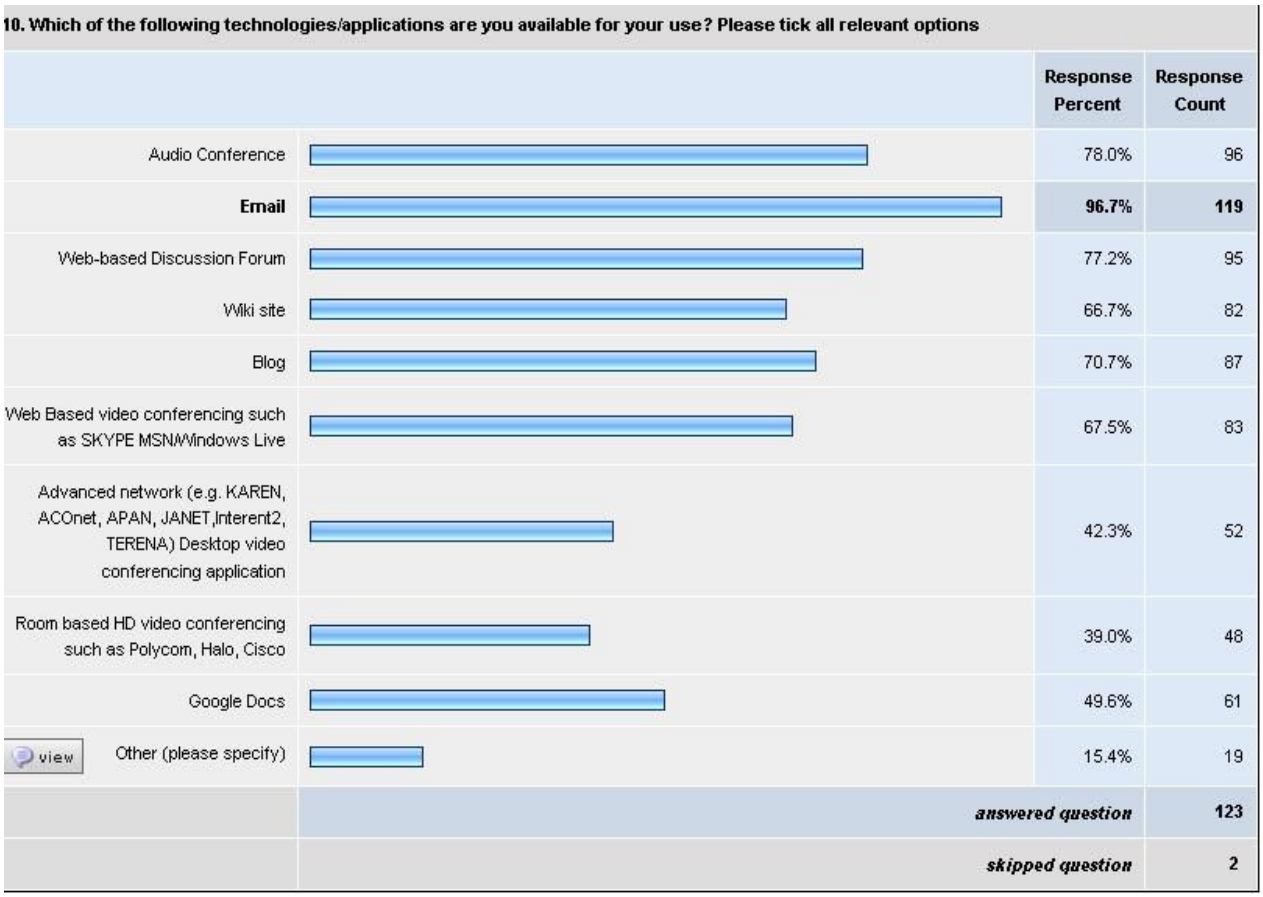


8. Is your workplace connected to an advanced high speed internet connection (e.g. KAREN, OCOnet, APAN, JANET, Internet2, TERENA)?	Response Percent	Response Count
Yes	67.5%	83
No	16.3%	20
Don't Know	16.3%	20
answered question		123
skipped question		2

Figure 16: connection to High Speed Net- N=123

Figure 16 shows that only 67.5% of respondents are connected to a high speed networks, compared to 100% connected to the commercial internet. 16.3% did not know whether their workplace is connected to a high speed network. This implies failure in disseminating information about the presence of such a network in the workplace, which may suggest levels of acknowledgement of the importance of the use of this network for the workplace. This highlights the fact that infrastructure is not only a technological but also a social as well as a political issue affected by the perceptions of benefits to the users in helping them perform their job better (Davis, 1989).

The survey asked respondents to list the technologies and applications available to them. Figure 17 illustrates their responses.



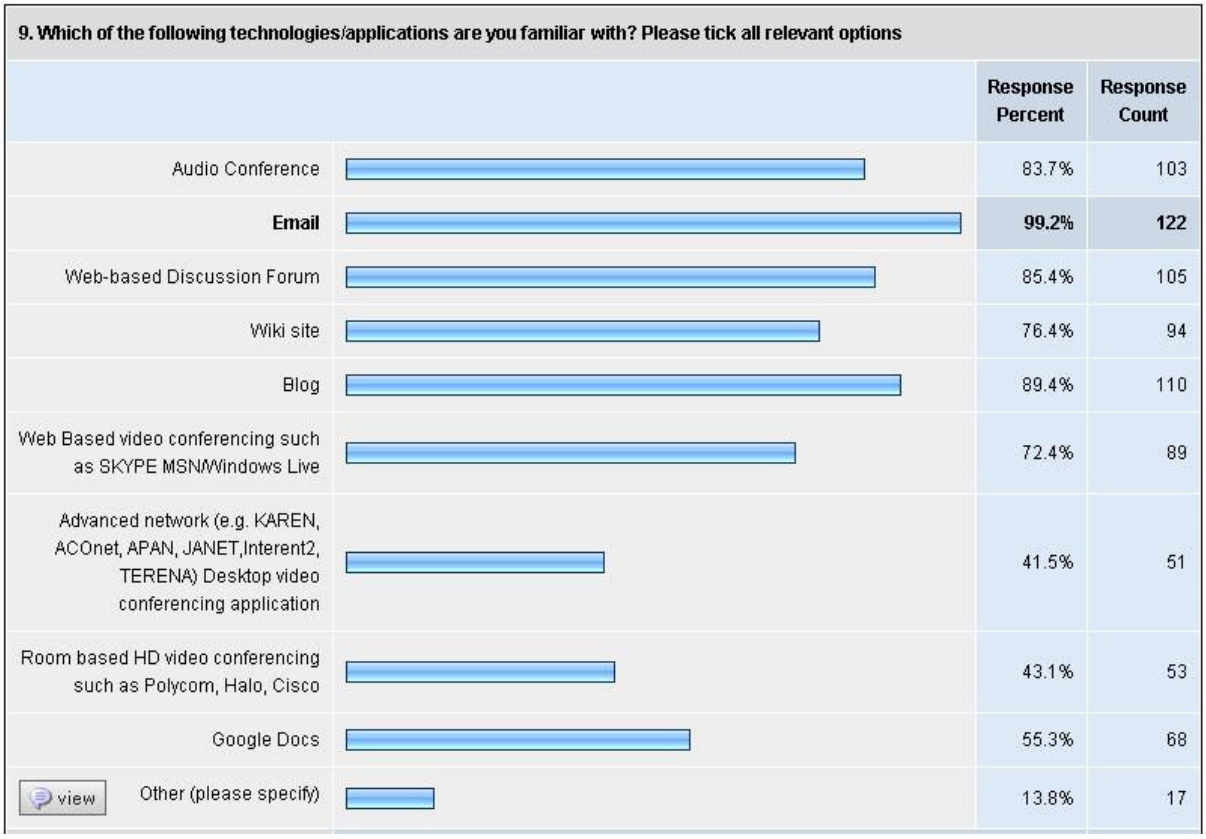
10. Which of the following technologies/applications are you available for your use? Please tick all relevant options	Response Percent	Response Count
Audio Conference	78.0%	96
Email	**96.7%**	**119**
Web-based Discussion Forum	77.2%	95
Wiki site	66.7%	82
Blog	70.7%	87
Web Based video conferencing such as SKYPE MSN/Windows Live	67.5%	83
Advanced network (e.g. KAREN, ACOnet, APAN, JANET,Interent2, TERENA) Desktop video conferencing application	42.3%	52
Room based HD video conferencing such as Polycom, Halo, Cisco	39.0%	48
Google Docs	49.6%	61
view Other (please specify)	15.4%	19
answered question		123
skipped question		2

Figure 17 Available Technologies- N=123

Figure 17 indicates that the highest level of *availability* (96.7%) is to email. At the next level down is the audio conferencing at 78% followed closely by Web based discussions at 77.2%. The lowest level of availability indicated is the room- based video conferencing at 39%.

Familiarity

The survey investigated how users' familiarity with technology affected the way they addressed the need to collaborate. Figure 18 illustrates the respondents' familiarity with different tools.



9. Which of the following technologies/applications are you familiar with? Please tick all relevant options

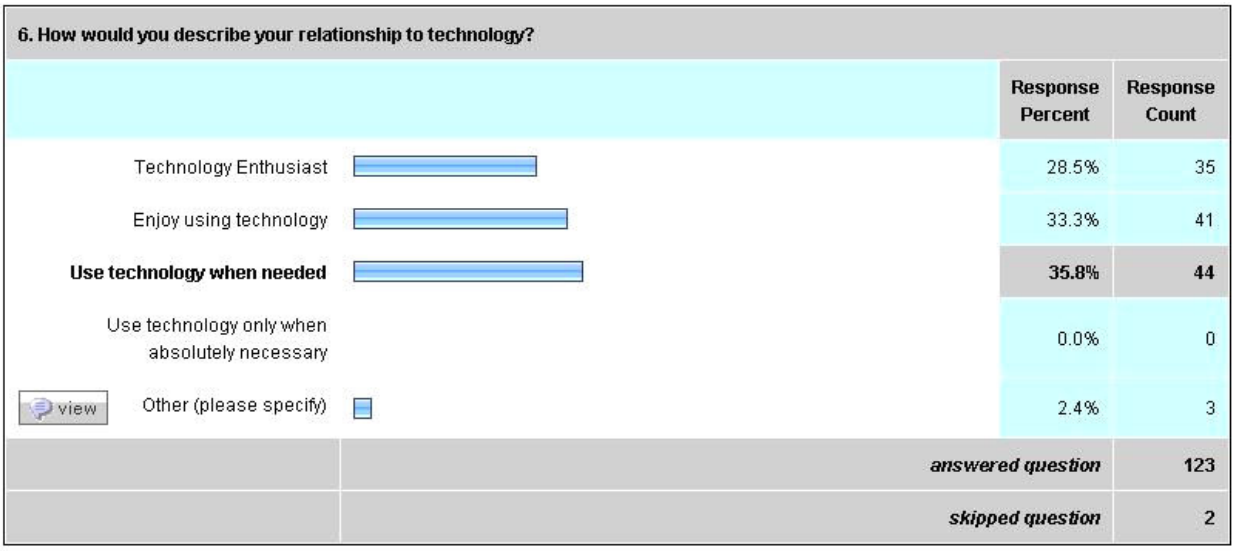
	Response Percent	Response Count
Audio Conference	83.7%	103
Email	**99.2%**	**122**
Web-based Discussion Forum	85.4%	105
Wiki site	76.4%	94
Blog	89.4%	110
Web Based video conferencing such as SKYPE MSN/Windows Live	72.4%	89
Advanced network (e.g. KAREN, ACOnet, APAN, JANET,Interent2, TERENA) Desktop video conferencing application	41.5%	51
Room based HD video conferencing such as Polycom, Halo, Cisco	43.1%	53
Google Docs	55.3%	68
view Other (please specify)	13.8%	17

Figure 18: familiarity with technology N=123

Figure 18, shows that the highest level of familiarity was attributed to email, at 99.2%, with blogs following at 89.4%, and audio conferencing at 83.7%.

Users and institutional perceptions and attitudes to collaborative technology

The survey asked respondents about their own general attitude towards using technology. Figure 19 illustrates respondents' description of their attitude.



6. How would you describe your relationship to technology?

	Response Percent	Response Count
Technology Enthusiast	28.5%	35
Enjoy using technology	33.3%	41
Use technology when needed	**35.8%**	**44**
Use technology only when absolutely necessary	0.0%	0
view Other (please specify)	2.4%	3
answered question		123
skipped question		2

Figure 19: Attitude to Technology- N=123

Figure 19 illustrates an almost equal division of attitudes between the different choice categories.
One respondent added *"Keen but need IT support which is generally lacking",* alluding to the relationship between use of technology, support, and its provision.

Figure 20 illustrates the level of affectivity respondents see in various e- conferencing tools:

49. How effective do you find these teleconferencing tools for collaborating?

	Most effective	effective	effective to some extent	effective in a limited way	Ineffective	Response Count
Phone call	15.9% (11)	56.5% (39)	23.2% (16)	4.3% (3)	0.0% (0)	69
Audio conference	7.1% (5)	50.0% (35)	31.4% (22)	8.6% (6)	2.9% (2)	70
Email	33.3% (23)	40.6% (28)	18.8% (13)	2.9% (2)	4.3% (3)	69
Web-based discussion forum	1.8% (1)	14.0% (8)	43.9% (25)	28.1% (16)	12.3% (7)	57
Wiki site	3.5% (2)	15.8% (9)	35.1% (20)	29.8% (17)	15.8% (9)	57
Blog	1.8% (1)	12.7% (7)	25.5% (14)	40.0% (22)	20.0% (11)	55
Web-based video conferencing tool (e.g. Skype, MSN /Live Windows	13.6% (8)	27.1% (16)	33.9% (20)	13.6% (8)	11.9% (7)	59
Desktop Video conferencing application using advanced network (e.g. KAREN, ACOnet, APAN, JANET Internet2, TERENA)	10.9% (6)	23.6% (13)	27.3% (15)	18.2% (10)	20.0% (11)	55
Room based HD video conferencing system such as Polycom, Murial, HALO Cisco	7.1% (4)	30.4% (17)	26.8% (15)	19.6% (11)	16.1% (9)	56
Google docs	2.3% (1)	18.6% (8)	34.9% (15)	18.6% (8)	25.6% (11)	43
Other	8.3% (1)	0.0% (0)	16.7% (2)	16.7% (2)	58.3% (7)	12
					Please specify view	10

Figure 20: effectiveness of technology- N=71

Figure 20, shows that when asked to rate the effectiveness of various technologies**, email is chosen by 73.9%** as rating between most effective and effective. This is followed closely by the telephone at 72.4% rating it between most effective and effective. The third choice at 57.1% is the audio conferencing.

Respondents were asked to rate the features enabled in Video Conferencing (VC). Figure 21 illustrates their responses

14. When choosing a teleconferencing technology how would you rate the following features?

	Most important	Important	Important to an extent	Marginally important	Not important	Response Count
Seeing people's faces	19.0% (19)	29.0% (29)	28.0% (28)	18.0% (18)	6.0% (6)	100
Hearing people's voices	72.0% (72)	20.0% (20)	4.0% (4)	1.0% (1)	3.0% (3)	100
Being able to share documents	20.6% (21)	41.2% (42)	24.5% (25)	7.8% (8)	5.9% (6)	102
Ease of use of the technology	57.0% (57)	36.0% (36)	3.0% (3)	1.0% (1)	3.0% (3)	100
Resources needed for purchasing the technology	28.9% (28)	32.0% (31)	26.8% (26)	6.2% (6)	6.2% (6)	97
Resources needed for using the technology	31.3% (31)	41.4% (41)	18.2% (18)	4.0% (4)	5.1% (5)	99
Access to the technology in my office	22.5% (23)	32.4% (33)	23.5% (24)	13.7% (14)	7.8% (8)	102
Level of interactivity enabled by the technology	24.2% (24)	42.4% (42)	19.2% (19)	10.1% (10)	4.0% (4)	99
Prevalence of the technology among my collaborators	36.0% (36)	42.0% (42)	13.0% (13)	3.0% (3)	6.0% (6)	100
Reliability	53.5% (54)	36.6% (37)	6.9% (7)	0.0% (0)	3.0% (3)	101
Flexibility of use across various bandwidth connections	27.1% (26)	31.3% (30)	22.9% (22)	12.5% (12)	6.3% (6)	96
flexibility in connecting to a variety of other teleconferencing tools	8.2% (8)	34.0% (33)	23.7% (23)	26.8% (26)	7.2% (7)	97
Other	21.4% (3)	0.0% (0)	0.0% (0)	0.0% (0)	78.6% (11)	14
					Other (please specify) view	8

Figure 21: Preferred Features in VC- N=103

Figure '21' shows that 72% of the respondents valued most highly the ability to **hear** collaborators.
57% respondents rated the **ease of use** of the technology as the most important; **reliability** was an issue which followed close behind at 53%. **Seeing** was rated by 19% of the respondents as most important and 29% valued seeing as important.

The survey asked respondent if their ratings would alter if they were to use VC for diverse tasks. Figure 22 illustrates the responses.

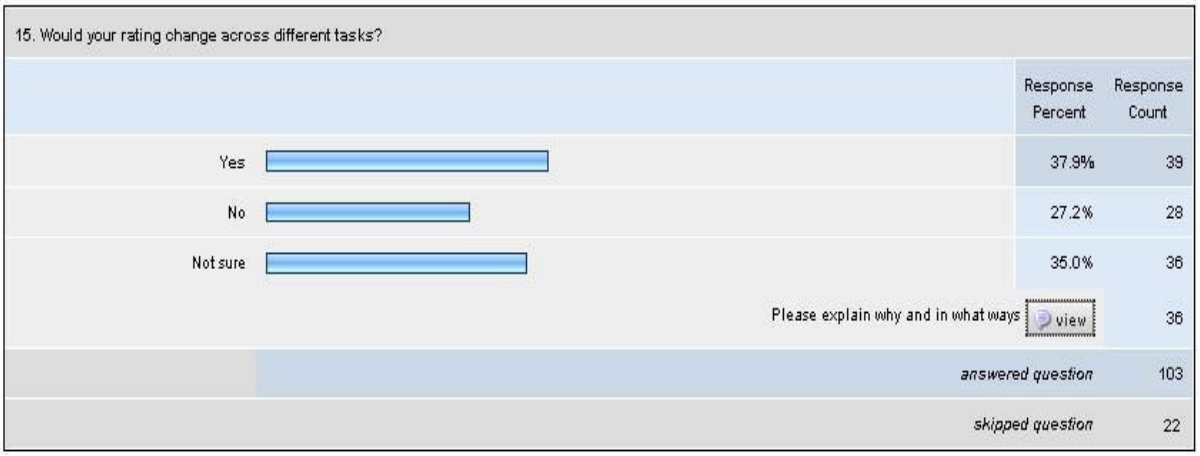


Figure 22- Features and Tasks- N=103

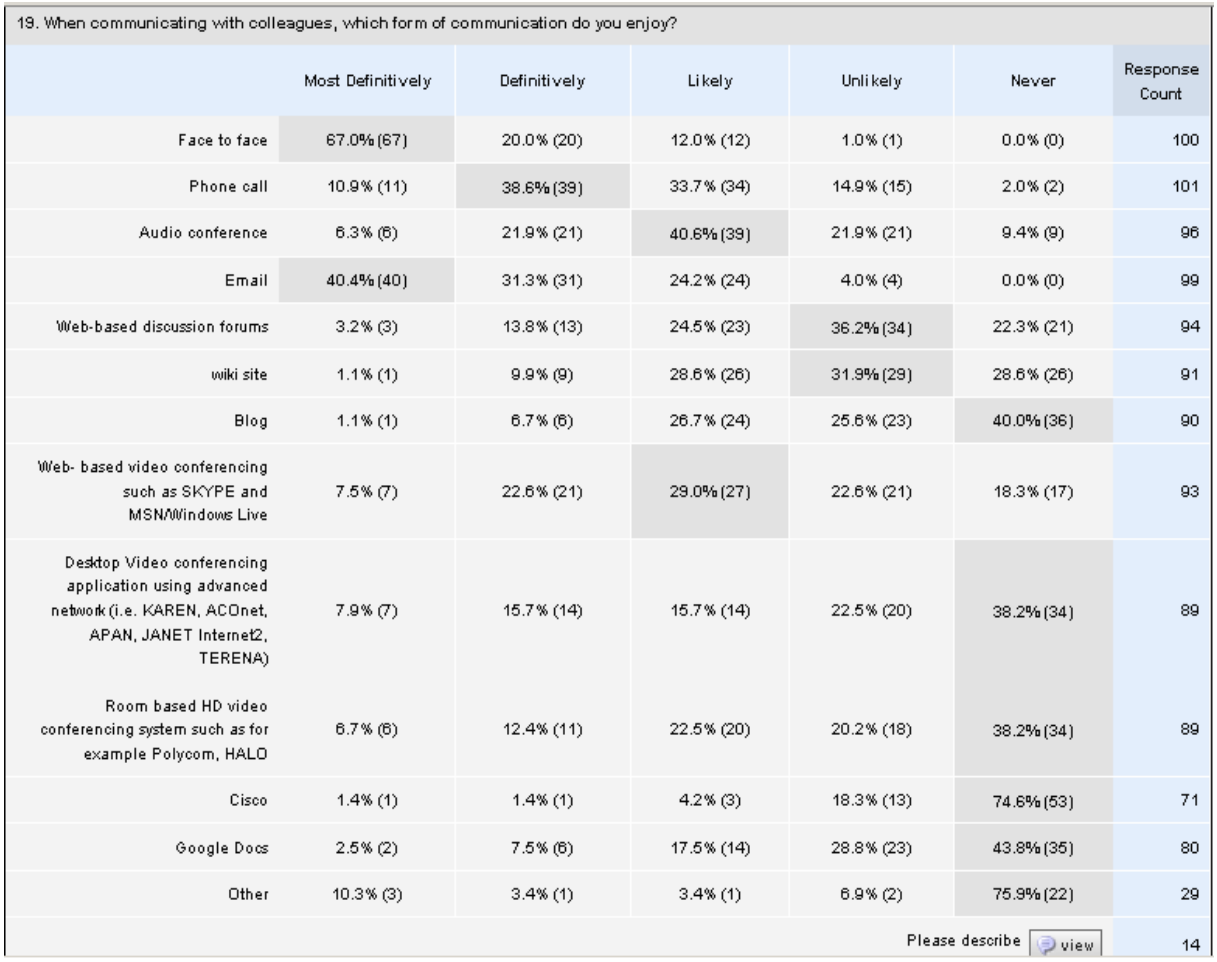
Figure 22 shows an almost evenly distributed response. Comments added shed light on the importance of the visual contact for different tasks and in different circumstances. Others talked about the reliability and availability and flexibility of the technology.

> *"For some applications the face-to-face visibility and body language is important, for others audio is sufficient. Audio is quite adequate for a short meeting (say up to an hour) with people you know well; for a longer meeting, and with people you don't know well, video is very helpful. Some meetings can be adequately informed with material posted or emailed in advance; others (for example for a technical or complex discussion) benefit from online presentations. Technology used needs to be matched to the purpose of the interaction".*

> *"If I know a group well, not seeing people' faces isn't a problem. Internal meetings are easier to organise & if things go wrong easier to reschedule so reliability, bandwidth etc less important. Seeing documents is less important too depending on what the meeting's for e.g. need them if want to review and finalise minutes or papers but not necessarily for more of a discussion based meeting".*

> *"For brainstorming to develop a project proposal, I need reliable and secure services, timely access to shared documents, and voice communications. For providing an asynchronous on-line course, I need compatibility with a variety of browsers and systems, flexibility across a variety of bandwidths, and the necessary resources for supporting the course - a different set of priorities".*

> Figure 23 illustrates the form of communication respondents enjoyed most.



19. When communicating with colleagues, which form of communication do you enjoy?

	Most Definitively	Definitively	Likely	Unlikely	Never	Response Count
Face to face	67.0% (67)	20.0% (20)	12.0% (12)	1.0% (1)	0.0% (0)	100
Phone call	10.9% (11)	38.6% (39)	33.7% (34)	14.9% (15)	2.0% (2)	101
Audio conference	6.3% (6)	21.9% (21)	40.6% (39)	21.9% (21)	9.4% (9)	96
Email	40.4% (40)	31.3% (31)	24.2% (24)	4.0% (4)	0.0% (0)	99
Web-based discussion forums	3.2% (3)	13.8% (13)	24.5% (23)	36.2% (34)	22.3% (21)	94
wiki site	1.1% (1)	9.9% (9)	28.6% (26)	31.9% (29)	28.6% (26)	91
Blog	1.1% (1)	6.7% (6)	26.7% (24)	25.6% (23)	40.0% (36)	90
Web- based video conferencing such as SKYPE and MSN/Windows Live	7.5% (7)	22.6% (21)	29.0% (27)	22.6% (21)	18.3% (17)	93
Desktop Video conferencing application using advanced network (i.e. KAREN, ACOnet, APAN, JANET Internet2, TERENA)	7.9% (7)	15.7% (14)	15.7% (14)	22.5% (20)	38.2% (34)	89
Room based HD video conferencing system such as for example Polycom, HALO	6.7% (6)	12.4% (11)	22.5% (20)	20.2% (18)	38.2% (34)	89
Cisco	1.4% (1)	1.4% (1)	4.2% (3)	18.3% (13)	74.6% (53)	71
Google Docs	2.5% (2)	7.5% (6)	17.5% (14)	28.8% (23)	43.8% (35)	80
Other	10.3% (3)	3.4% (1)	3.4% (1)	6.9% (2)	75.9% (22)	29
					Please describe view	14

Figure 23: Form of communication enjoyed -N=103

Figure 23, shows that the most enjoyed form of communication is the face-to-face encounter (67%). This is followed by email (40.4%). Phone calls were rated by 38.6% as definitely but not most definitely enjoyable.

Respondents were asked to describe the reasons for their most preferred choice. They referred to availability, richness of the media, ease and immediacy of use, and level of intrusion to other tasks.

> *"I like face to face interactions because those are most 'full' communication contexts - voice, gesture, facial expression, body language - all add to the experience. Other forms delete or curtail at least some"*

> *"e-Mail is most convenient communication- simple immediate and little interference to on-going tasks. Requires least planning. Face-to-face when require conversation rather than exchange of info, followed by other tasks in descending order and convenience and immediacy of contact".*

Respondents were then asked to describe the reasons for the most unlikely choice. They referred to availability of the technology among colleagues, and its compatibility with those of colleagues, familiarity with the technology, and need, proximity to available technology, expense, and no added value in using the technology

"*Not generally used or understood by most of my colleagues*".
"Unavailability, not preferred by the people I communicate with"
"Haven't used and at this point don't need to"
"I don't know what they are or have never used them"
"Little use of these tools"

"I wouldn't want to use a room based video conferencing unless it was in the same building, at present the access we have is on another site which would take time to set up and I've no idea what systems it would be compatible with to tell the others involved".
"Some technologies are expensive and require time to learn how use"
"It's a pain when technology gets in the way as it so often does. And many of these don't add enough value to compensate for their problems..."

Figure 24 describe respondents' perceptions of the nature of e-conferencing meetings.

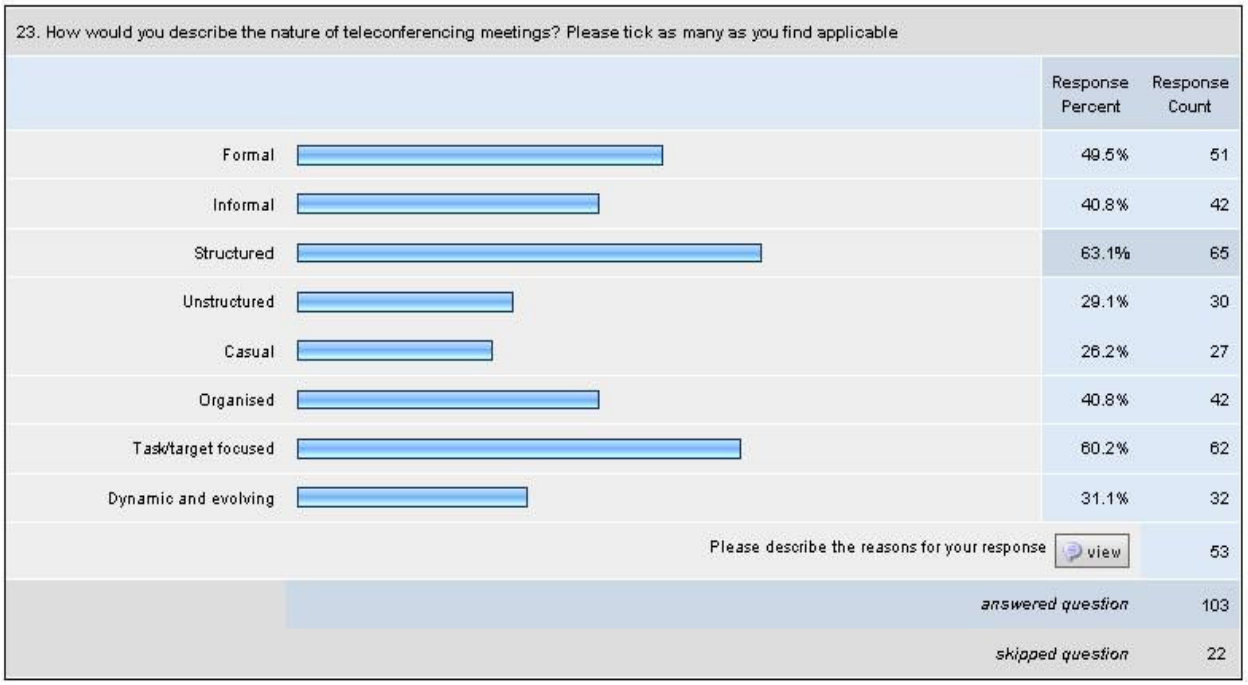


Figure 24: Nature of e-Conferencing - N=103

Figure 24 shows that 63% of the respondents found e-conferencing meetings structured, 60.2% found them task focused, and 49.5% found them formal.

Use and Practices

The survey inquired about the contexts in which e-conferencing technologies were utilised.

74% of the respondents said that they use e conferencing technologies for communicating with colleagues.
The survey asked respondents to describe the tasks for which e conferencing tools were applied. Figure 25 illustrates the different uses and their levels of practice

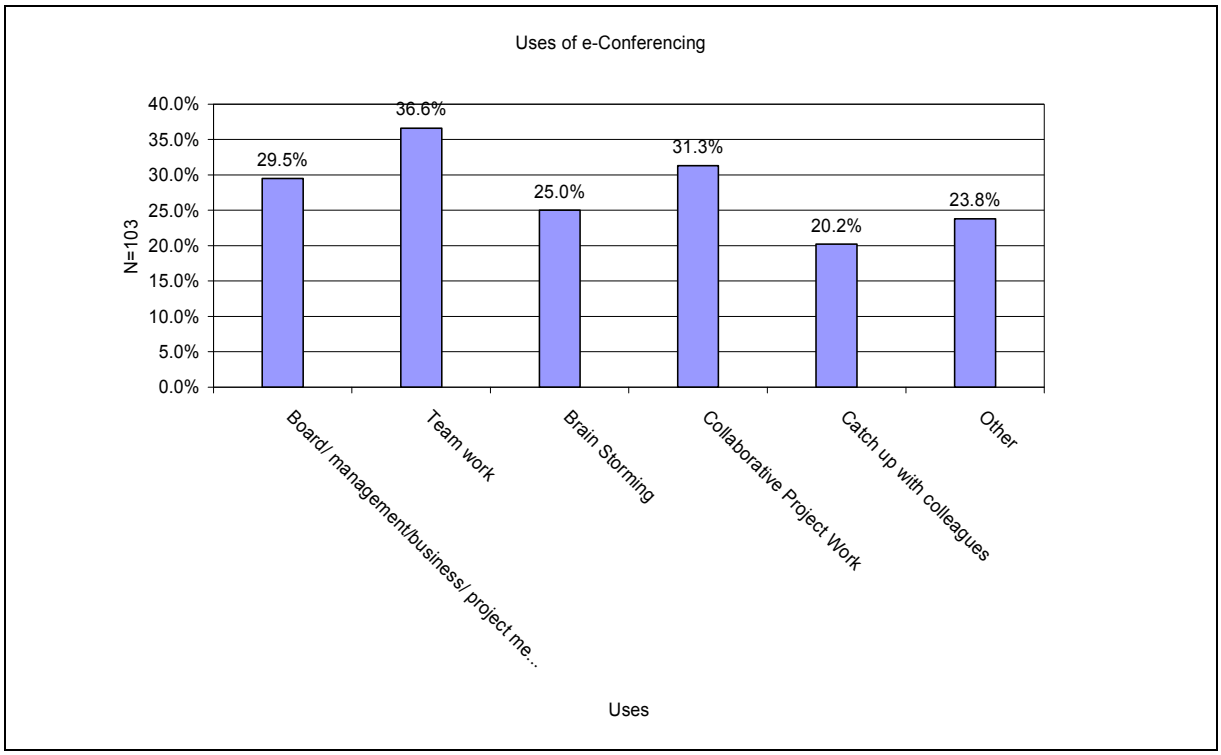


Figure 25: N=103- Uses of e-Conferencing

Figure 25 shows that *team work* is the highest use noted by the participants, followed by *collaborative project work*. These coincide with the comments made by respondent about their work situation where team members and project collaborators are scattered across sites:

"I work with a multi-site research team, both nationally and internationally"

"….there are 4 sites involved in the team and we need to collaborate to get through the project work".

Figure 26 illustrate the frequency in which respondents used e- conferencing technologies to communicate with colleagues.

12. At what frequency do you teleconference with colleagues?

	Response Percent	Response Count
Everyday	5.5%	5
3-4 times a week	7.7%	7
1-2 times a week	25.3%	23
Once a fortnight	18.7%	17
Once a month	18.7%	17
Less	24.2%	22
answered question		91
skipped question		34

Figure 26: N=91- Frequency of e-conferencing

Figure 26 shows that 25.3% of the respondents used e-conferencing technologies 1-2 a week. However, 24% reported a less than once a month use.

96% said they would communicate from home if they had to meet with people from different time zones
70.3% of the respondents use their home computer for communicating with colleagues based at other time zones.

The survey asked respondents to identify which of the e- conferencing tools they would choose for collaborating with off site colleagues. Figure 27 illustrates the responses.

50. When collaborating with off site colleagues which of the following communications would you choose?

	In all cases	In most cases	In some cases	Very rarely	Never	Response Count
Face-to face meeting	14.5% (10)	30.4% (21)	44.9% (31)	7.2% (5)	2.9% (2)	69
Phone call	15.9% (11)	34.8% (24)	40.6% (28)	7.2% (5)	1.4% (1)	69
Audio conference	6.1% (4)	15.2% (10)	53.0% (35)	15.2% (10)	10.6% (7)	66
Email	47.1% (33)	40.0% (28)	11.4% (8)	0.0% (0)	1.4% (1)	70
Web-based discussion forum	1.7% (1)	5.0% (3)	30.0% (18)	28.3% (17)	35.0% (21)	60
Wiki site	3.3% (2)	4.9% (3)	29.5% (18)	26.2% (16)	36.1% (22)	61
Blog	1.7% (1)	3.4% (2)	18.6% (11)	28.8% (17)	47.5% (28)	59
Web-based video conferencing tool (e.g. Skype, MSN /Live Windows	15.6% (10)	9.4% (6)	28.1% (18)	18.8% (12)	28.1% (18)	64
Desktop Video conferencing application using advanced network (e.g. KAREN, ACOnet, APAN, JANET Internet2, TERENA)	5.1% (3)	13.6% (8)	15.3% (9)	13.6% (8)	52.5% (31)	59
Room based HD video conferencing system such as Polycom, Murial, HALO Cisco	5.3% (3)	10.5% (6)	22.8% (13)	17.5% (10)	43.9% (25)	57
Google docs	1.9% (1)	7.7% (4)	21.2% (11)	17.3% (9)	51.9% (27)	52
Other	0.0% (0)	0.0% (0)	12.5% (2)	6.3% (1)	81.3% (13)	16

Figure 27: Choice of tools- N=71

Figure 27 shows that email was chosen by 87.1% in *all* or *most* cases. Phones calls were chosen by 50.7% in *all* or *most* cases. Interestingly 44.9% chose face- to- face in *all* and *most* case and an equal percentage chose face- to -face *in some cases*.

The survey asked respondents to identify the e- conferencing tools they use. Figure 28 illustrates the levels of use of the various tools.

36. When collaborating with off- site colleagues which of the following do you use?

	In all cases	In most cases	In some cases	Very rarely	Never	Response Count
Face-to face meeting	10.3% (7)	11.8% (8)	55.9% (38)	19.1% (13)	2.9% (2)	68
Phone call	13.0% (9)	31.9% (22)	43.5% (30)	10.1% (7)	1.4% (1)	69
Audio conference	0.0% (0)	20.6% (13)	42.9% (27)	22.2% (14)	14.3% (9)	63
Email	50.0% (36)	43.1% (31)	5.6% (4)	0.0% (0)	1.4% (1)	72
Web-based discussion forum	0.0% (0)	3.2% (2)	22.6% (14)	27.4% (17)	46.8% (29)	62
Wiki site	0.0% (0)	8.1% (5)	19.4% (12)	22.6% (14)	50.0% (31)	62
Blog	0.0% (0)	1.6% (1)	16.1% (10)	16.1% (10)	66.1% (41)	62
Web-based video conferencing tool (e.g. Skype, MSN /Live Windows	1.6% (1)	23.4% (15)	14.1% (9)	17.2% (11)	43.8% (28)	64
Desktop Video conferencing application using advanced network (e.g. KAREN, ACOnet, APAN, JANET Internet2, TERENA)	0.0% (0)	4.9% (3)	21.3% (13)	11.5% (7)	62.3% (38)	61
Room based HD video conferencing system such as Polycom, Murial, HALO Cisco	0.0% (0)	8.3% (5)	16.7% (10)	21.7% (13)	53.3% (32)	60
Google docs	1.7% (1)	1.7% (1)	15.3% (9)	15.3% (9)	66.1% (39)	59
Other	0.0% (0)	4.5% (1)	9.1% (2)	0.0% (0)	86.4% (19)	22
					Please specify view	9

Figure 28: Use of E conferencing tools- N=73

Figure 28 shows that email is the most used e- conferencing tool for collaborating with off-site colleagues. 55.9% of the respondents said they use face to face meetings in some cases. This trend was followed by 43.5% using phone calls, and 42.9% audio conferencing. According to figure 28 video conferencing tools are very rarely used. The lowest use (62.3%) was of desktop video conferencing using high speed networks. A slightly higher use was that of room base video conferencing systems.

Respondents were asked if access to certain technologies is associated with specific roles or positions in the organisation

67.6% said that it does not. In their commenting respondents said:

"More accessible to senior positions, but not totally disallowed for lower levels, depending on motivation"

"Technology is most accessible to those working in technology related fields"

"Yes, currently teleconferencing are used for administrative and academic reasons. For example, directors meetings or academics workgroups".

"Suspect the managers have much better collaboration suites and tools for communicating than we do as researchers"

How people do Remote Collaboration

This section asks respondents to convey their attitudes and choice of method of collaboration when having to communicate with people working on sites other than their own. Respondents were asked to convey their attitudes towards travelling as an option for meeting colleagues working at other locations. Figure 29 illustrates their responses.

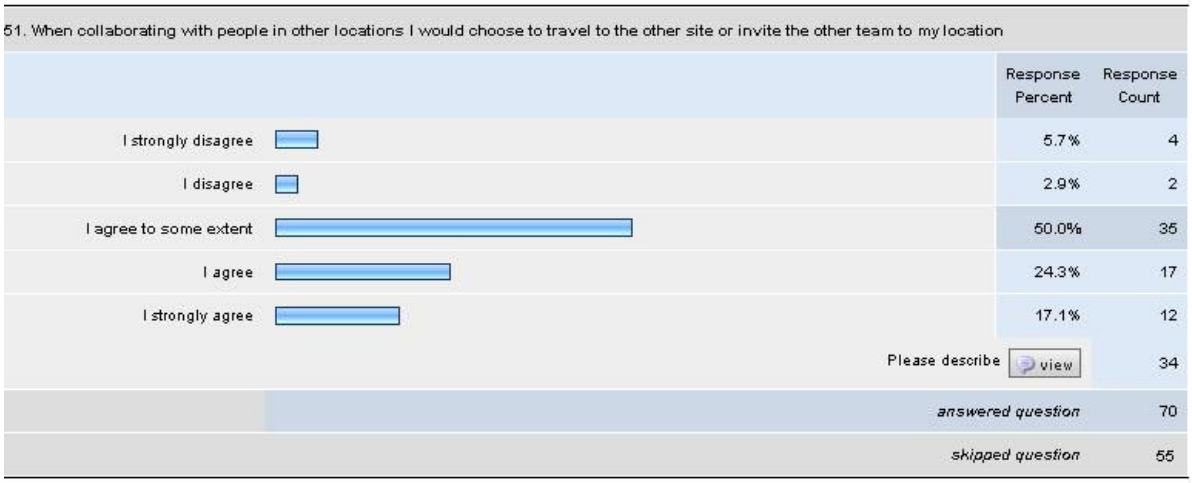


Figure 29: Travelling – N-70

Figure 29 shows that 50% agreed to some extent with the statement of "when collaborating with people in other locations I would choose to travel to the other site or invite the other team to my location.

When asked to explain their choice respondents commented about the essence of collaboration, the effectiveness of face- to- face for initial establishment of relations, and the need to balance between face- to- face and the use of technologies for remote collaboration. Respondents also alluded to issues of context, task, and commitment, the constraints of time and expenses, and also to environmental concerns.
Out of the 34 comments written in response to the question, 21 (61.7%) indicated the importance of face- to- face. 3 responses (8.8%) mentioned concerns for the environment. 7 responses (20.5%) mentioned issues of time and expense. Below are some of the comments contributed clustered into different aspects identified.

The adventure of collaboration

"Travel to the other side or invite the other team to my location is ***part of the adventure of collaboration.*** *Although several subjects and issues could be discussed and resolved remotely, attend team members face to face in my location or travel to others location helps to improve human relationship".*

Initial contact:

"*Always useful at least once to establish good working relations"*

"In some cases it is necessary to be together, even if only for psychological reasons, but considering the environment, it is probably never critical"

"For initial meetings, this is often very helpful, particularly when I haven't met the other people before or when there are difficult issues to sort out, and where the travel is not too

extensive or expensive. But it takes time and if I can better use the time and reduce environmental costs, I will".

"Face to face meeting is essential for first meeting. Politeness and gives you real insight into their operation".

"From time to time and frequency depending on how far they are away; f2f is especially important for setting the scene at the start of a project/activity"

"Initial face to face meeting are important sustaining these can then be done through technology such Video conferencing"

Commitment
"A balance between the two options is important, I travel and then they travel, it shows commitment and interest in the collaboration"

Time expense and the environment
"Face to face discussion is most effective, but not always possible (time, travel expenses)
"Environmental concerns; time"

The survey asked participants to indicate their position in relation to the statement "when collaborating with people in other locations I would choose to organise **an audio conference**" 44.3% agreed to some extent. When asked to comment on their choice respondent generally alluded to the fact that this would not be the optimal choice, but others pointed out the benefits of audio conferencing as a cost effective and readily available tool.

> *"Good alternative to face to face"*
>
> *"If that was all that was possible"*
>
> *"Useful, but not the best*".
>
> *"If a meeting is not possible. If video=conferencing is not possible".*
>
> *"If that is the only or best option in terms of money and/or time and/or facilities'.*
> *".....it is easier to link by audio-conferencing than videoconf Where homeworkers involved, it is usually easier for them to join by audio-c than video-c".*
>
> *"Happy to work at this distance in this way. Cost and time would otherwise prohibit a lot of possibilities for good work".*
>
> *"Sometimes – depends for example on the type of project, its stage, how well I know the other people, how much money is available...."*
>
> *"Cheap, simple, effective"*

The survey asked people to describe their attitude towards using web **based video** conferencing when collaborating with people in other locations.
42.9% said they would use it to some extent. When asked to describe the reasons for their choice respondents referred to technology related issues such as proficiency reliability and

availability. They also compared between face-to-face and technology mediated meetings, and the ability of the technology to meet task requirement.

In relation to technological proficiency respondents said that:

"Technology challenges"
" Wouldn't know how"
"don't know how"

In relation to technological reliability respondents said that the:

"Technology unreliable "
"Technology rarely works".

In relation to the availability of the technology, respondents said that:

"Not normally available. Good if available and not costly"
"if available"

In relation to benefits of Web based conference in comparison to face to face meeting respondents described it as the Next best thing

"If face to face option is not feasible, this will be next best".

In relation to task needs

"Where wanted to show technical content or presentation"
"When I need to discuss some informal subject".
"When I need to discuss some informal subject".

One respondent summed up their attitude to Web based video conferencing saying that use is:

"Held back only by reservations about the technology and cost".

The survey asked respondents to comment about choosing to use advanced network desktop videoconferencing tools. The division of the responses to this question were different to those in the previous questions addressing meeting with off site collaborators. In relation to travel, audio conference, or video conference using web-based tools, the highest rate of responses was to the statement:" I agree to some extent". However, when asked about the advanced network desktop videoconferencing choice, the responses were distributed almost evenly across the scale as shown in figure 30.

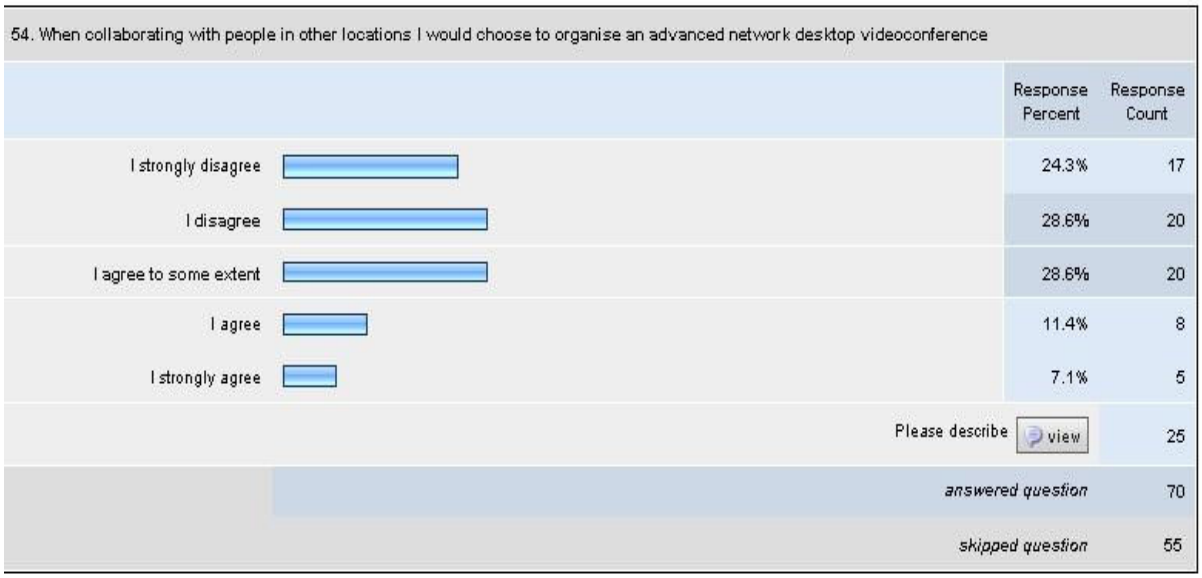


Figure 30: advanced network VC-N=70

The same phenomenon occurred when asked about the room based video conferencing tools as shown in figure 31.

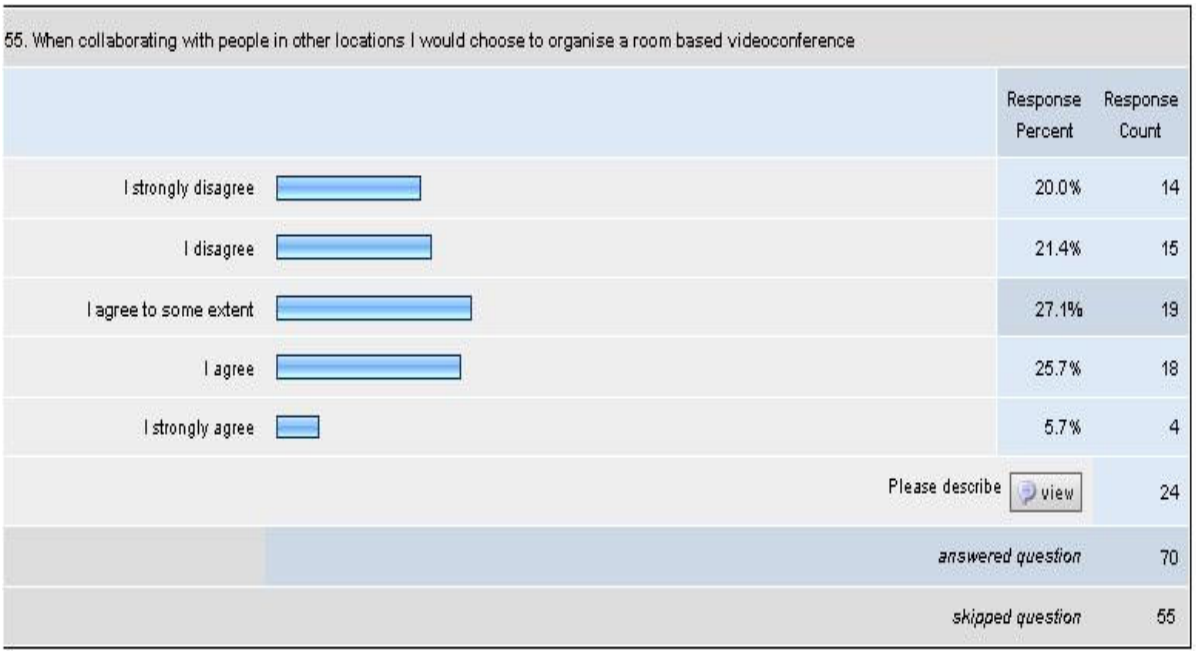


Figure 31: Room Based VC- N=70

This is intriguing because when asked to elaborate on their choice the responses were not dissimilar, stating that their response is *"Same as above"*
Others when asked about the **Advanced Network Desktop VC systems** reiterated factors such as technology's support , its availability, familiarity, time and resources , nature of task**,** saying:

Technology supporting
"If technology allows it"
"High quality experience"

Availability
"Depends on the technology available"
"Not available"
"Most people don't have this facility"
"Too few colleagues have the same"

Familiarity
"Need to know more about them…"

Time and resources
"No time or resource"
Task
"When I need to have a meeting with several persons and I need to discuss formally a subject".

When asked about '**room based video conferencing** the same categories appeared once more, with respondents saying that they need to be more familiar with the technology, it needs to be more available, the nature of the task:

Availability

"Depends on the technology available"

"If it was available at both ends"

Familiarity

"No idea. Have not used it".

Task

"Sometimes – depends for example on the type of project, its stage, how well I know the other people, ..."

"Prefer desktop but depends if it is a large meeting etc"

"When I need to give some academic lecture or course".

However some new aspects emerged here relating to:

acquaintance of collaborators

"Where I already know people involved and there are same numbers at both ends (roughly)"

Complexity associated with room based VC

"If I am right, this is too much hassle and too far away and getting bookings etc. yuk."

"Tried it, too many problems".

On the whole a trend of preference can be detected as shown in figure 32.

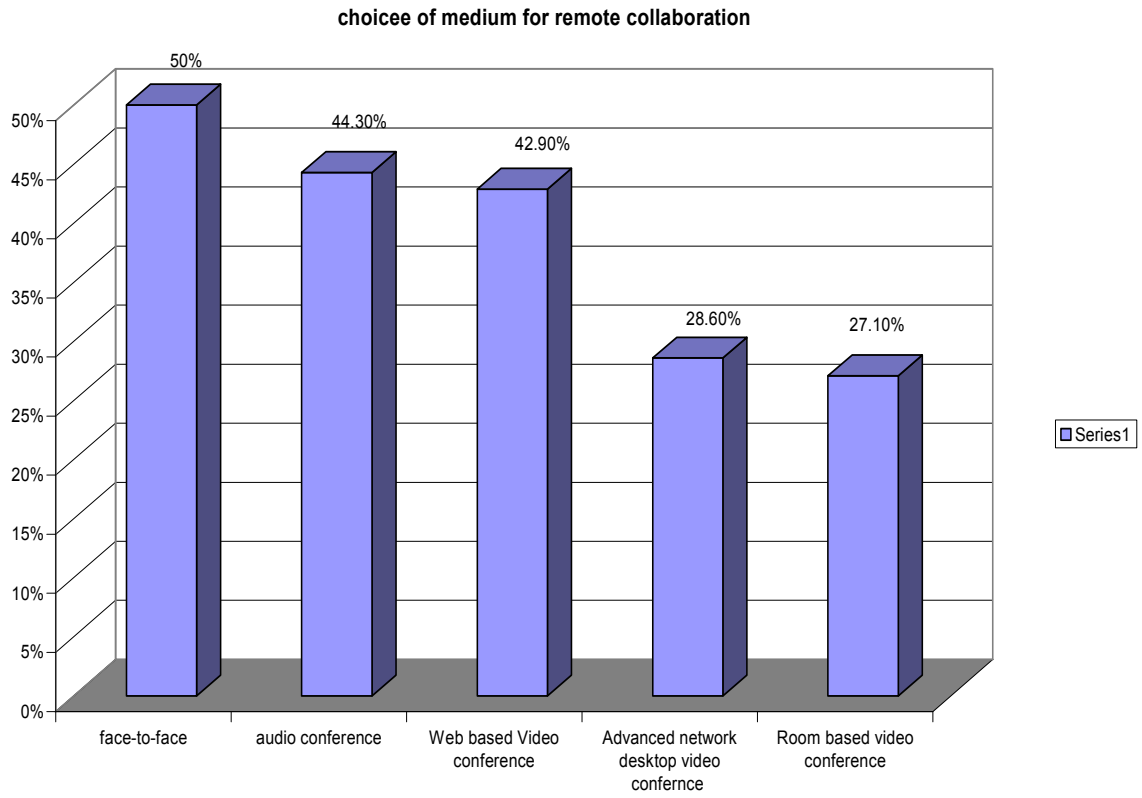


Figure 32: Choice of Medium for Remote Collaboration

Figure 32 shows that the most preferred medium is face-to-face, followed by audio conferencing, which is very closely followed by Web -based video conferencing. There is a distinct drop in the level of preference between these three media and the video conferencing with the desktop option faring slightly higher than the room based video conferencing. This trend may indicate a preference to the technically simpler and more available and accessible.

Participating in conferences – modes and reasons

This section investigates the reasons and mode of participation in international conferences. First the survey asked respondents to define the reason for participating in an international conference. Figure 33 illustrates the responses.

56. What are Your reasons for participating in an international conference?

	I strongly disagree	I disagree	I agree to some extent	I agree	I strongly agree	Response Count
Exchange knowledge	7.6% (5)	0.0% (0)	15.2% (10)	47.0% (31)	30.3% (20)	66
meet colleagues	6.0% (4)	3.0% (2)	13.4% (9)	38.8% (26)	38.8% (26)	67
Test my ideas	6.1% (4)	6.1% (4)	21.2% (14)	45.5% (30)	21.2% (14)	66
Learn new things	6.0% (4)	6.0% (4)	11.9% (8)	44.8% (30)	31.3% (21)	67
Learn what others are doing	6.1% (4)	3.0% (2)	7.6% (5)	42.4% (28)	40.9% (27)	66
enjoy a break from my daily routine	9.7% (6)	12.9% (8)	32.3% (20)	32.3% (20)	12.9% (8)	62
Meet new people	6.2% (4)	4.6% (3)	24.6% (16)	43.1% (28)	21.5% (14)	65
Visit new places	5.0% (3)	16.7% (10)	40.0% (24)	31.7% (19)	6.7% (4)	60
Other	50.0% (3)	0.0% (0)	16.7% (1)	0.0% (0)	33.3% (2)	6
					Other (please specify) view	7
					answered question	70
					skipped question	55

Figure 33: participating in conference-N=70

A sum of the responses choosing the two columns 'I strongly agree" and "I agree" reveals that the highest percentage of responses were given to the statement: "learn what others are doing" (83.3%). Figure 34 illustrates the ratings of the summed up columns of responses.

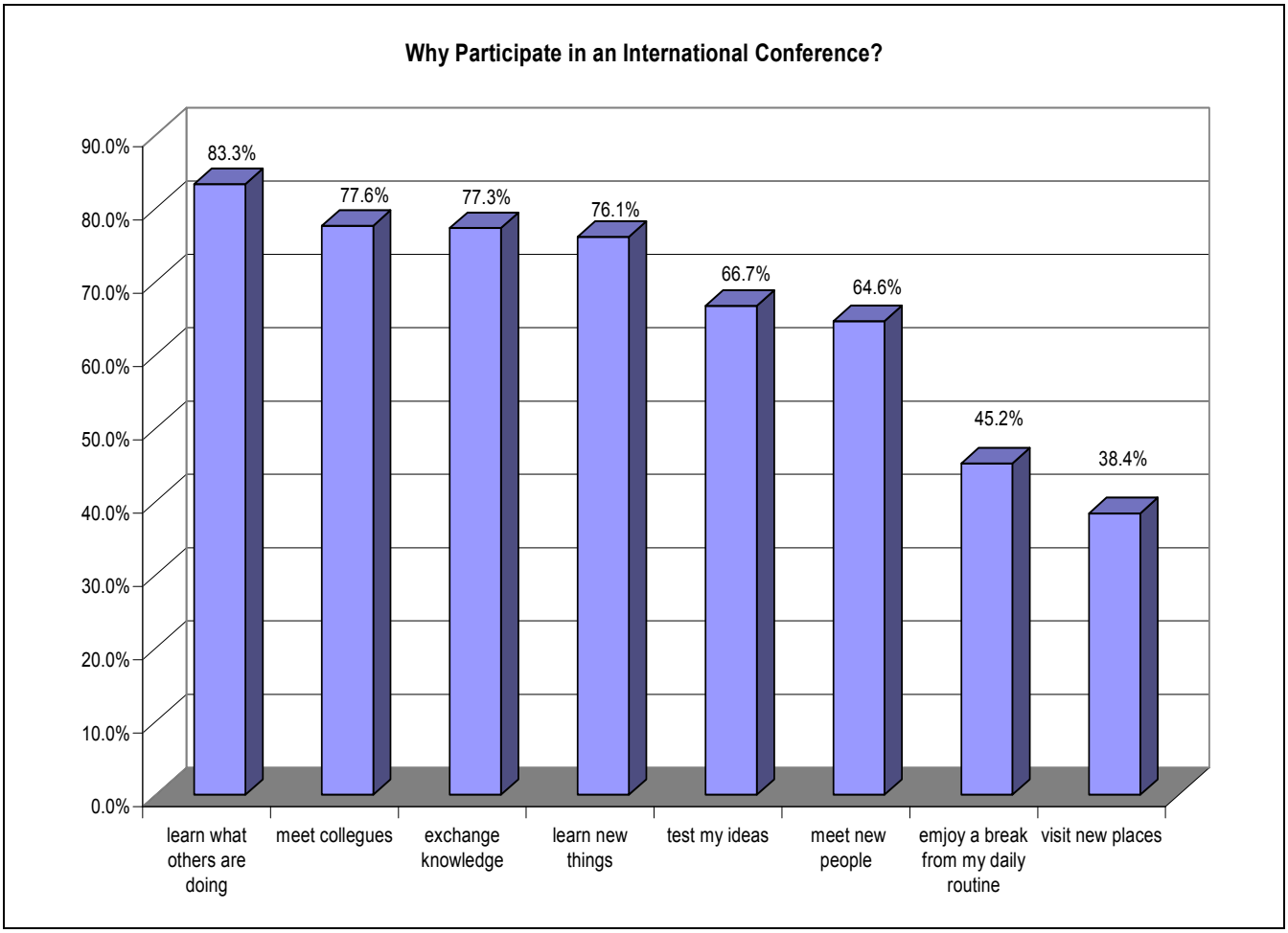


Figure 34: Factors affecting participation in conferences

It is interesting to note that the highest percentage was given to the 'learn what others are doing' followed by 'meeting colleagues', while meeting 'new people' received only 64.6%,. The results imply that conferences are meeting places for established cliques of colleagues parading their recent work. The innovativeness of meeting of new people and learning new things is rated lower. This is surprising because according to responses in other parts of the survey (as well as other studies), conferences would have been the perfect opportunity to meet new people and establish new contacts, which could then be followed up using e conferencing, which as participants commented needs the pre requisite of having established an initial familiarity. The situation portrayed here depicts international conferences as being mostly about knowing what's new with a colleague one has not seen since the last conference and to a lesser extent exploring new territories, testing new ideas, and meeting new people.

Respondents were asked to identify the reason they would choose to physically attend a conference/workshop or seminar taking place in a location other than their own. Figure 35 illustrates the responses.

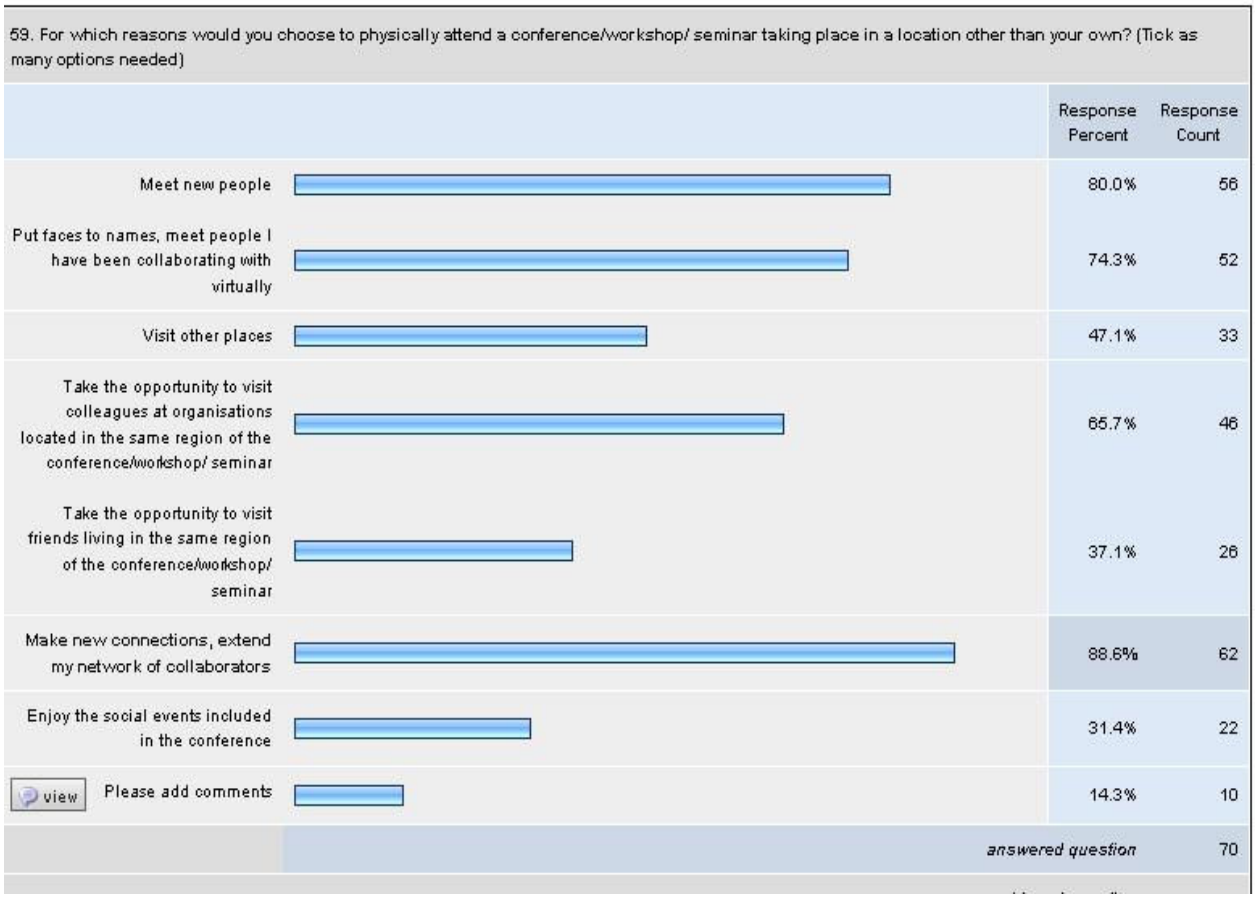
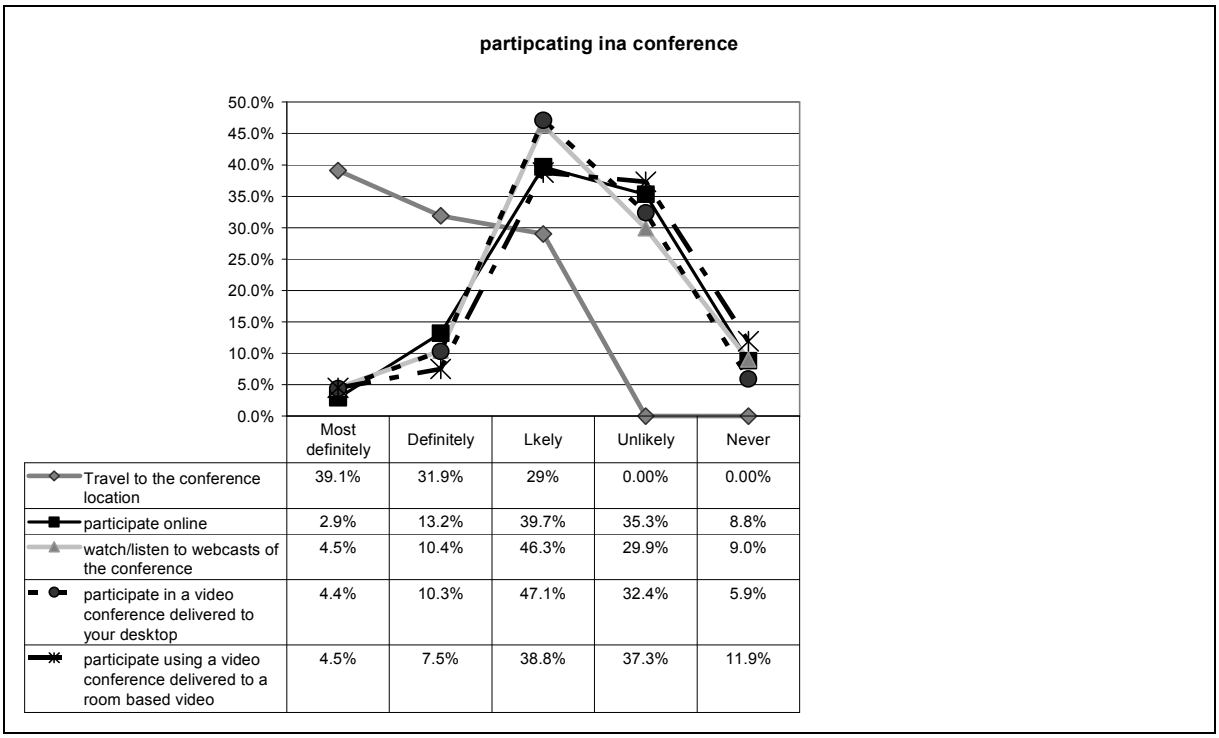


Figure 35: reasons for physical participation-N=70

Figure 35 shows that most respondents wanted to make new connections and extend their network of collaboration. This was closely followed by the desire to meet new people. In third place was the desire to put faces to names of people they have been collaborating with virtually. The question posed here is similar to the one asking about reasons for participating in a conference however the responses prompted here are different. The meeting of new people is the most prominent purpose. This may have arisen because the question specifically stated physical attendance rather than a general 'participation' in conference. Also the responses here tend to imply use of travel for meetings beyond the primary designated destination and purpose. Here the desire to extend acquaintances was highlighted by the responses.

Respondents were asked to choose their mode of participation in international conferences. Figure 36 shows the responses.

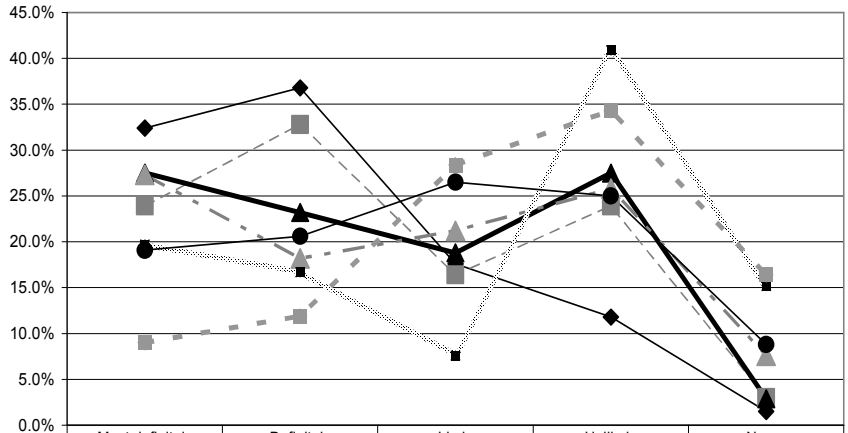


	Most definitely	Definitely	Lkely	Unlikely	Never
Travel to the conference location	39.1%	31.9%	29%	0.00%	0.00%
participate online	2.9%	13.2%	39.7%	35.3%	8.8%
watch/listen to webcasts of the conference	4.5%	10.4%	46.3%	29.9%	9.0%
participate in a video conference delivered to your desktop	4.4%	10.3%	47.1%	32.4%	5.9%
participate using a video conference delivered to a room based video	4.5%	7.5%	38.8%	37.3%	11.9%

Figure 36: how people participate- N=70

Figure 36 clearly indicates that the most preferred mode of participation is to travel to the conference location.

Respondents were asked to identify the circumstances under which they would choose virtual participation in a conference. Figure 37 illustrates their responses.



	Most definitely	Definitely	Lkely	Unlikely	Never
Lack of Travel Budget	32.4%	36.8%	17.6%	11.8%	1.5%
Need to Attend a high numner of conferences and cannot travel to all	23.9%	32.8%	16.4%	23.9%	3.0%
Unable to be absent from my workplace for the length of time required for physical participation	27.5%	23.2%	18.8%	27.5%	2.9%
Family situation prevents me from being absent from home	27.3%	18.2%	21.2%	25.8%	7.6%
Health condition prevents me from travelling	19.7%	16.7%	7.6%	40.9%	15.2%
Conscious decision to reduce carbon footrpint created by travel	19.1%	20.6%	26.5%	25.0%	8.8%
peer/social pressure calling for reduction of travel for environmental reasons	9.0%	11.9%	28.4%	34.3%	16.4%

Figure 37: choosing the virtual -N=70

Figure 37 shows that the highest factor influencing the choice of virtual participation is lack of travel budget seconded by inability to be absent from work. Environmental factors are low on the list

The survey asked respondents about their organisation's attitude towards the use of e conferencing for reducing travel. Figure 38 illustrates their responses.

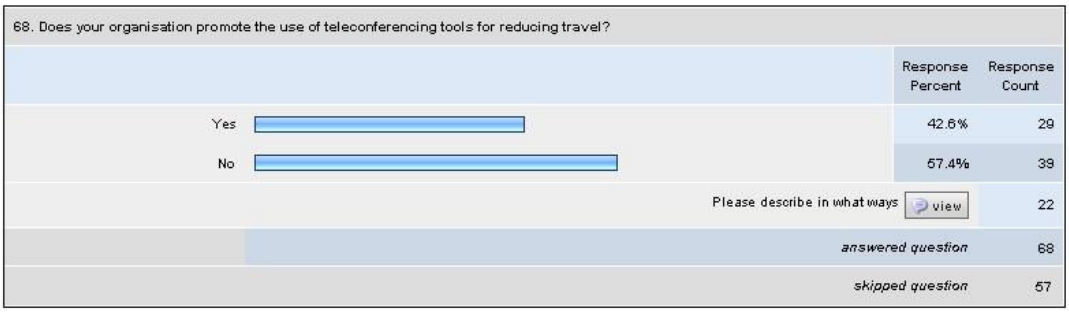


Figure 38: organisation promoting teleconferencing -N=68

Figure 38 shows a slight negative trend with 57.4% saying that the organisation does not promote e- conferencing.

Comments made by the respondents are clustered according to aspects emerging:

Not quite yet

"Still some culture constraints"
"Not yet at a conscious level -- but it will"
"Not that I'm aware of"

"Not specifically yet"
"Not overtly, not yet!"
"Certainly see this as a driver of development as yet no form policy in this regard could well emerge in the future"

Technology issues

"Karen is promoted"
"Depending on task and project/activity"
" *Most meetings are conducted using Oracle Collaboration Suite and teleconference".*
Prevalence and Availability will encourage wide use

Organisational support

"*But with limited administrative support to do so"*
"Seminars and lectures can be accessed via teleconferencing tools"
" *But individuals within it do"*
"But we have had emails about phone bills being too high. There should be a concerted advertising campaign within the workplace of alternatives".
" *Because of multi-site campus"*

Reduce travel

"Yes, currently teleconferencing are used to reduce travel to others campus for academic and administrative reasons".
"Yes, but travelling is allowed when is properly justified".

Interviews findings

Interviewees came from the same three categories as the participants of the survey.

4. Those calling for environmentally friendly solutions to research needs;
5. Those who develop remote collaborative technologies;
6. Those who advocate the use of remote collaborative tools for enhancing collaborative research

Key aspects identified in interviews were to do with issues relating to the uptake of technology and its embedding in research practices. Interviewees commented that

"A lot of Video Conferencing systems are sitting around this country and are not being used"

"We all have skype but we are all hesitant to use it - why = I don't know"

"People don't see others doing it , need to be embedded in our lives"

"*Need to see it [VC] as a normal part of life"*

"We have been challenged [to conduct conference via e conferencing] but no one wants to be first. The risks are too high in case they will fail".

Other comments related to users' capabilities and the technology's usability and stability

"VC presents difficulties of technology"

"The producing companies say we can do it ourselves as it is simple. Technically we can do it ourselves but need confidence"

"People need confidence in using it"

"Need training"

"Support staff"

"…its not just turn around and do -it's a hassle"

"You need stability, more bandwidth, more Hi Def"

"…… but when I had to collaborate in VC because I was alone in the evening at the building and there was no one to set the video conferencing for me.

Interviewees also commented on the issue of collaborative culture

"The whole collaboration thing, we really don't have that much".

"…you are trained to work solo; we don't really train people to collaborate".

"Why should I collaborate?"

"In other domains outside social science there are vast networks of collaboration. Social scientists are doing less" .

Other comments related to issues of practices and habits

"*People just do it [collaboration] we work with each other"*

"Collaboration is really hard. Any group that gets together has to negotiate because of authorship, work styles and people not doing work, if you find people you can collaborate it's rare and then its magic a lot of times it's not going t work"

"International -Europe is easy for collaboration but US ASIA because of time issues. If you are collaborating in words (asynchronous) is good".

"We don't interact with colleagues down the hall because we know all of us are so busy, so we don't do it across teleconferencing".

"We can teleconference if you already know the person, Families use Skype"

"I like being in the room with other people – because we are a group if I do this on my laptop I am very selective, and we also will be multitasking – doing our emails while"

"Do e conferencing technologies make us do anything different or just more of the same we have been doing before?"

Some interviewees commented about the role of organisations and governments in the uptake of e-conferencing for reducing travel and about organisational structures and their affects on collaborative research.

"There is a lot of rhetoric in the national level but not enough a lot being done, maybe individuals can say something. I would agree to work at the grass-root level. But you need to change the rules at the top, because otherwise government can come and bugger it all up"

"Problems in publishing multidisciplinary". PBRF is going to force people back into discipline moulds because it all going to be based on the ranking of the journals and the multidisciplinary ones are not ranked highly. If you want people to read it put it in one of the multidisciplinary but if you want high rating put it into the high ranking but then you will get only 6 people who will read it.

Others commented about changing existing face- to- face practices to virtual meetings and so reduce travel

"Conferences are businesses, so if we go virtual, how would you collect the coin from them"

"Traveling is easy and well supported"

"Creating a crisis will create a need to change practices"

"There will be a change in consciousness to the environment"

"Will it really matter if some marginal benefit were derived from travel for 30 hours to be at a face-to-face meeting? We will develop the technology and ways of using it that make virtual meetings useful, and we will not travel so much".

"The things that travel around the world are ideas and for that we have plenty of energy to move it around the world".

"Conference travel will diminish – paradigm shift by showing how it works differently".

"Encourage more sustainable lifestyle at the individual level. We need the rules of the game in government. We are using more coal and more oil. We try to tell government to step back and understand what the pathology. But it's not working because of the ruling ideologies. They think that technology will solve all, I am an engineer and I know that technology will not solve all".

Survey and interviews summary

The survey and interviews set out to identify and map the various factors entailed in the uptake of e- conferencing technologies within the context of a knowledge society/economy

which requires collaborative research but at the same time is calling for environmentally friendly solutions, and the reduction of travel related emissions.

The investigation contributes to the field of study challenging the assumption that the provision of remote collaborative technologies will alter existing practices and promote e-conferencing as a mean for sustainable collaborative research, arguing that non technological factors need to be addressed in order for technologies to be adopted(Allan & Thorns, 2009; Bayo-Moriones & Lera-Lo´ pez, 2007; Davis, 1989; A. Dillon & M.G. Morris, 1996; Greenberg, 2009; Markard & Truffer, 2008; Parente & Prescott, 1994; Strewart & Mohamed, 2004; Van Akkeren & Cavaye, 1999). The findings here reiterate these arguments further suggesting that the technology itself will not trigger uptake of e collaborative research, but rather as one respondent put it:

"The ethos, the culture, the colleagues and the tools … in that order"

The focus here is on searching for a way that will contribute to our understanding of how various factors involved in the process relate to each other, and in so doing will contribute to findings ways of transferring rhetoric into practice.

Table 4 summarises key statements made by participants in this study and exposes the inconsistencies between the rhetoric and practice. The rhetoric expresses acknowledgement of the benefits entailed in using technology for collaborative research. However, the practices constructed through factors associated with collaborative practice and those associated with users' technology relationship do not portray implementation of the rhetoric.

Table 4- Rhetoric vs. Practice

Rhetoric	Practice
People enjoy collaboration	Career structures and evaluation models promote individualistic competitiveness hence deterring people from collaborating
People are wired to collaborate	Different cultures sometimes cause difficulties for the collaboration "Its tough to arrange"
People see the benefits in collaboration as increasing diversity, efficiency and providing stimuli	Collaboration is a buzzword, doing it for compliance is a waste of time There is no tangible reward for collaborative practices
Work is increasingly multidisciplinary	Career success is measured by discipline based publications which provide higher impact factor and therefore are more desirable
Organisation see collaboration as beneficial for purposes of securing funding and acquiring prestige	No real incentives provided Organisations do not see benefits of collaboration for the project
81.2% of the respondents said that their organisation encourages collaboration,	Officially organisations encourage collaboration but do not provide sufficient institutional and cross-institutional backing. Collaboration is not given a high

Rhetoric	Practice
	importance and most collaboration is imitated by individuals
Organisations seem to have a strong sense of the potential benefits entailed in collaboration	Organisation lack a sense of what collaboration could /should mean and as a result there is no tangible reward for collaborative practices.
Organisations see the benefits in using e conferencing technologies for reducing travel	57.4% of organisations do not seem to promote the shift to e conferencing.
People see the benefits in video conferencing because it saves time and travel and more friendly to the environment	People refrain from using video conferencing because of technological challenges; lack of support; no time to train and get proficient in its use; costs; consumes time for setting up; need technician on site; compatibility and interoperability with systems of collaborators; time zone issues prevent using workplace high speed network facilities and technical support.
People prefer face to face meeting over all other media because of the richness of the communication which enables building trust and establishing initial contacts. Literature suggests that video conferencing is the next best thing to face to face meetings.	The most ubiquitous medium used for remote collaboration is email, which literature rates very low in media richness. Reasons given are: 1. Most available 2. Most familiar 3. Perceived as most effective 4. Is rated second to face-to-face in level of enjoyment 5. Convenient- simple and immediate 6. Not intrusive to other tasks 7. Easy to use

Table 4 alludes to the numerous factors entailed in the process of uptake and highlights the need for these to be acknowledged and addressed in ways which will facilitate greater consistency between rhetoric and practice and hence increase the alignment between what is desired and required in the work context of the knowledge economy operating in environmentally friendly practices.

In highlighting the inconsistencies between rhetoric and practice table 4 illustrates the non linear flow between the various practices, and the complexity entailed in the process of adopting sustainable collaborative research practices.

Table 4 suggests that the implementation of e-conferencing technologies for conducting remote collaboration without the need to travel is a non linear process comprised of interrelating elements. To enable further understanding of the process in a non linear way, figure 39 depicts the overarching elements emerging from the findings and illustrates their interrelatedness.

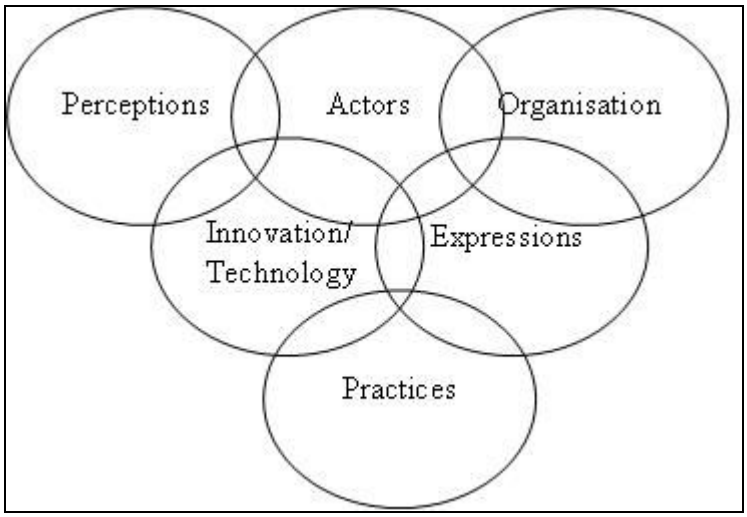


Figure 39- The elements in uptake

The rhetoric - practice gap illustrated in table 4 implies that each of the elements illustrated in figure 39 is an agent capable of constructing others, but is also being constructed by others. Acknowledging this two-way interrelated flow indicates the break away from linear perceptions of uptake process and heralds its conceptualisation from a System's approach.

Addressing uptake from a Systems' Approach – A new method

System's approach enables the study of systems as organised and interrelated entities rather than conglomerates of parts. It emphasises the importance of the relationships between the parts arguing that these facilitate *the emergence phenomenon* in which the whole is different to the parts (Bertalanffy, 1971; Juarrero & Rubino, 2008; Miller & Page, 2007).

The report shows that the findings of the qualitative data collected in this study are organised in a manner which highlights their interrelatedness. This laid down the foundations for the development of a new method of analysing uptake processes.

The new method represents the issues identified in the findings as factors and agents constructing the uptake of e-conferencing, however, not as isolated entities but rather as interrelating parts networked together to create systems participating in the Greater system representing the whole process of uptake of e-conferencing.

The method provides a non binary perspective of the process of uptake, and enables a multi level view of the process as emerging from within the relationships of factors within their systems as well as through the relationships between the various *factor systems* creating the process as a whole. The ability to follow the emergence as created through these different levels of systems allows for disassembly of the whole at different points(Miller & Page, 2007). This ability facilitates informed intervention for successful implementation of e conferencing technologies. However, it also poses strategic difficulties in addressing multiple factors embedded in one or more *factor systems* all at once. To address these difficulties the method identifies the impact value of the various *factor systems* hence creating a prioritisation mechanism. This mechanism allows decision makers to design different phases in an implementation plan based on the priority levels of *factor systems*. Priority levels are established in accordance with the level of prominence a *factor system* displays within the

Greater system. The prioritisation strategy facilitates localised yet interlinked approach and provides a systemic approach to the implementation of e- conferencing.

The prioritisation of factors is obtained through the adoption of concepts found in Social Network Analysis' Centrality and Cohesion routines, and is illustrated using Graph theory.

The method demonstrated here dissects systems comprising processes of uptake and offers a clearer view of what is entailed in the *emergence* (Miller & Page, 2007) of such processes as wholes. In doing so it contributes to our understanding of how such processes are created through the various interrelating parts.

From Data to Systems- An overview

The smallest unit identified in the data are statements made by respondents in the study. These are clustered under *Factor Categories*, which are then associated with agencies and operational statuses to form Factor *Systems*.
Various Factor Systems are networked through agencies and operational statuses to form the Greater System encompassing the implementation processes as a whole.

Figure 40 illustrates the emergence of the Greater system.

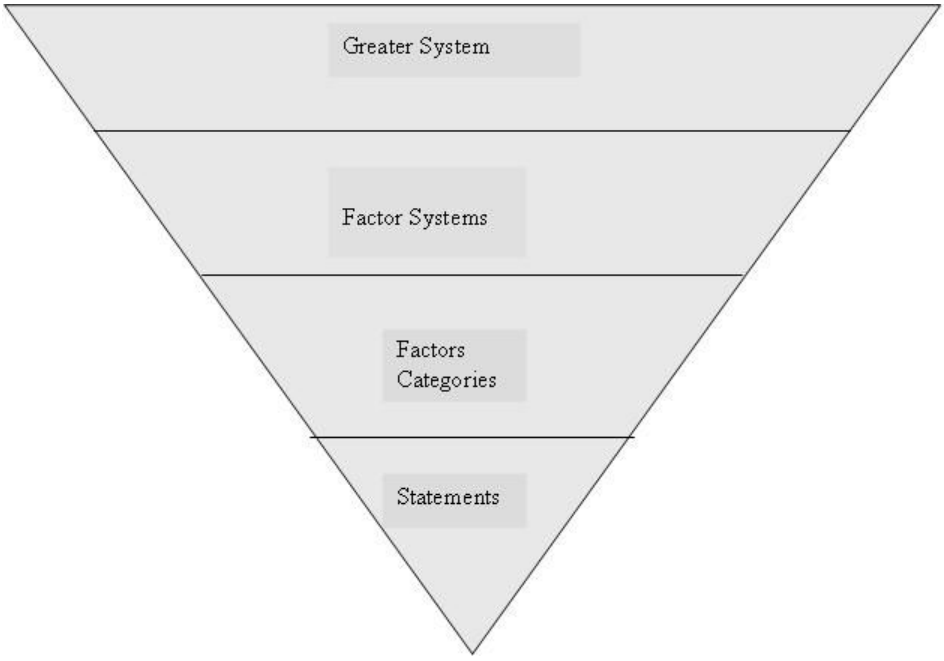


Figure 40-The emergence of the Greater System

Figure 41 illustrates the interrelatedness of the agents and statuses identified in the data.

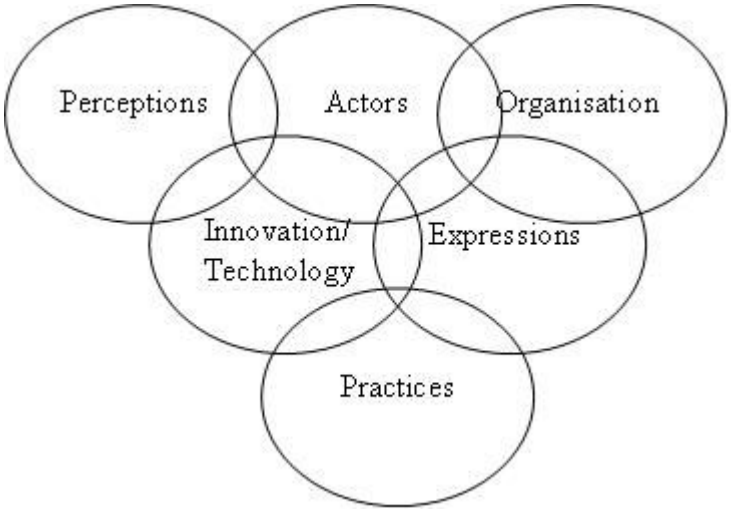


Figure 41- interrelating elements

From data to systems – The Process

The organisation of the data follows the division of the survey into three operational *statuses*; perceptions, practices, expressions. Content analysis of qualitative data exposed three *agencies* implied in the wording of the responses to the open ended questions. The agencies identified are: Actors, Organisations and Technology

- Actor – representing individuals,
- Organisation –representing workplace
- Technology – representing all technology associated factors

In addition, the analysis revealed that in some cases more than one agency was implied in relation to a single factor. For example, some factors related to actor and organisation, hence they needed to be categorised as Actor/Organisation, others as Actor/ Technology, Organisation/Technology, or Actor/Organisation/Technology

The analysis of the data identifies a total of 140 qualitative statements representing the key issues raised by participants in the study. The extraction of these statements was done by trolling the qualitative parts of the survey and transcribing the interviews. Duplicating ideas were eliminated. The 140 statements were clustered into 29 *Factor Categories* showing here:

1. Barriers to collaboration
2. Collaboration value for Complexity
3. Collaborative culture
4. Collaborators
5. Competitiveness
6. Context
7. Diversity
8. Efficiency
9. Environment
10. Expectations of e conferencing
11. Face-to-Face
12. Funding
13. Going virtual
14. Human Nature and Collaboration
15. Multidisciplinary
16. Networking

17. Organisational support
18. Quality of work
19. Rhetoric Practice gap
20. Standard practice
21. System of factors
22. Task Technology
23. Technological support
24. Technology Availability
25. Technology Reliability
26. Time
27. Travel
28. User Technology
29. Work Relations

The categories were derived by truncating the key notions expressed in a group of statements. Each *factor category* represents an aggregate of statements contributing to the formation of a certain factor involved in the uptake of e-conferencing. However, the process of uptake is constructed by more than mere aggregates of statements, as these are associated with *agencies* and are found in various *statuses.* Each statement in each of the *factor categories* was associated through the survey questionnaire to one or more *statuses*. Analysis of the wording revealed the *agency* with which users associated the statement..
Multiple statements associated with the same status and or agency can be seen as linked together. In other words, the links across *statuses* and *agencies* create relationships between statements within the *factor category*. To demonstrate this phenomenon Table 5 shows how statements are linked within the *factor category* 'Barriers to Collaboration'.

Table 5-barriers to collaboration factor system matrix

Statements	Actor	Organisation	Actor/Organisation	Actor/Tech	Org/Tec	Actor/Org/Tech	Perceptions	Practices	Expressions
non conducive structures		X						X	
organisation has minimal sense of collaboration		X						X	
organisations do not overtly promote e conferencing		X						X	
measurement of academic careers		X							X
PBRF hinders collaboration			X				X		
Lack of high importance for collaboration			X				X		
Careers are individualistic constructs			X				X		
PBRF			X					X	
lack of incentive			X					X	

The circles showing in Table 5 highlight how agencies and statuses shared by various statements link them together. Visualising the relationships between statements, statuses, and agencies revealed an entity that is more than an aggregate of statements clustered into a *Factor Category*. The interrelated entity that emerges is a '*Factor System'*.

Using Graph Theory Table 5 was transformed into a graph illustrating the relationships through which statements are linked through statuses and agencies to create a *factor system.*

Figure 42 illustrates the *factor system* of "Barriers to Collaboration". The circles in the illustration represent the *statements,* the boxed circles represent the *agencies*, and the boxes represent the *statuses*.

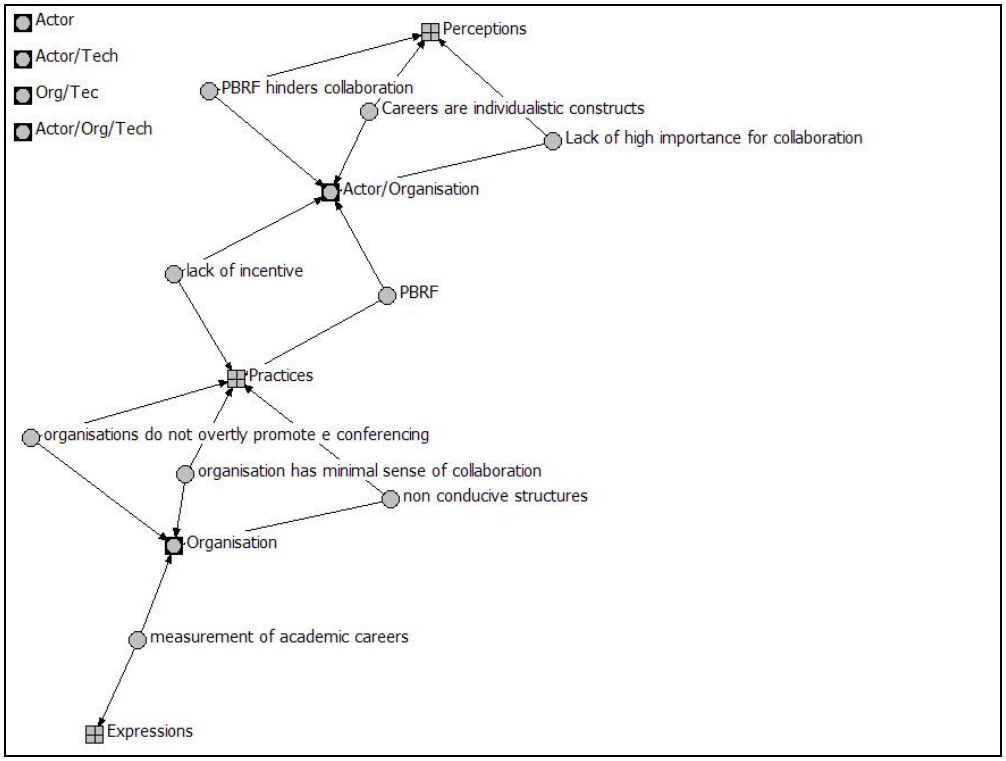


Figure 42- Factor System- Barriers to Collaboration

Each of the 29 factor categories was processed in the same way to create and visualise them as *factor systems*, some of which are demonstrated here in figures 43-45:

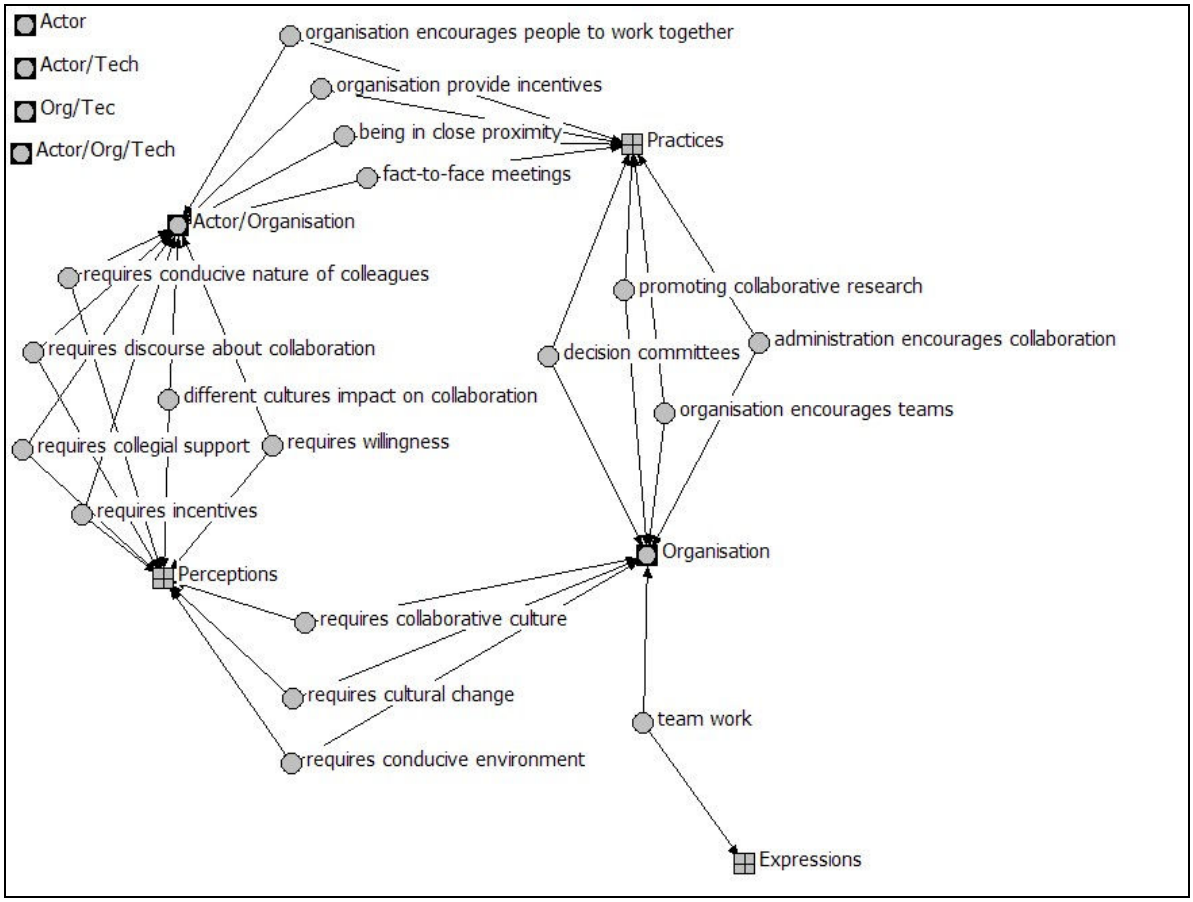


Figure 43 - Factor System -Collaborative Culture

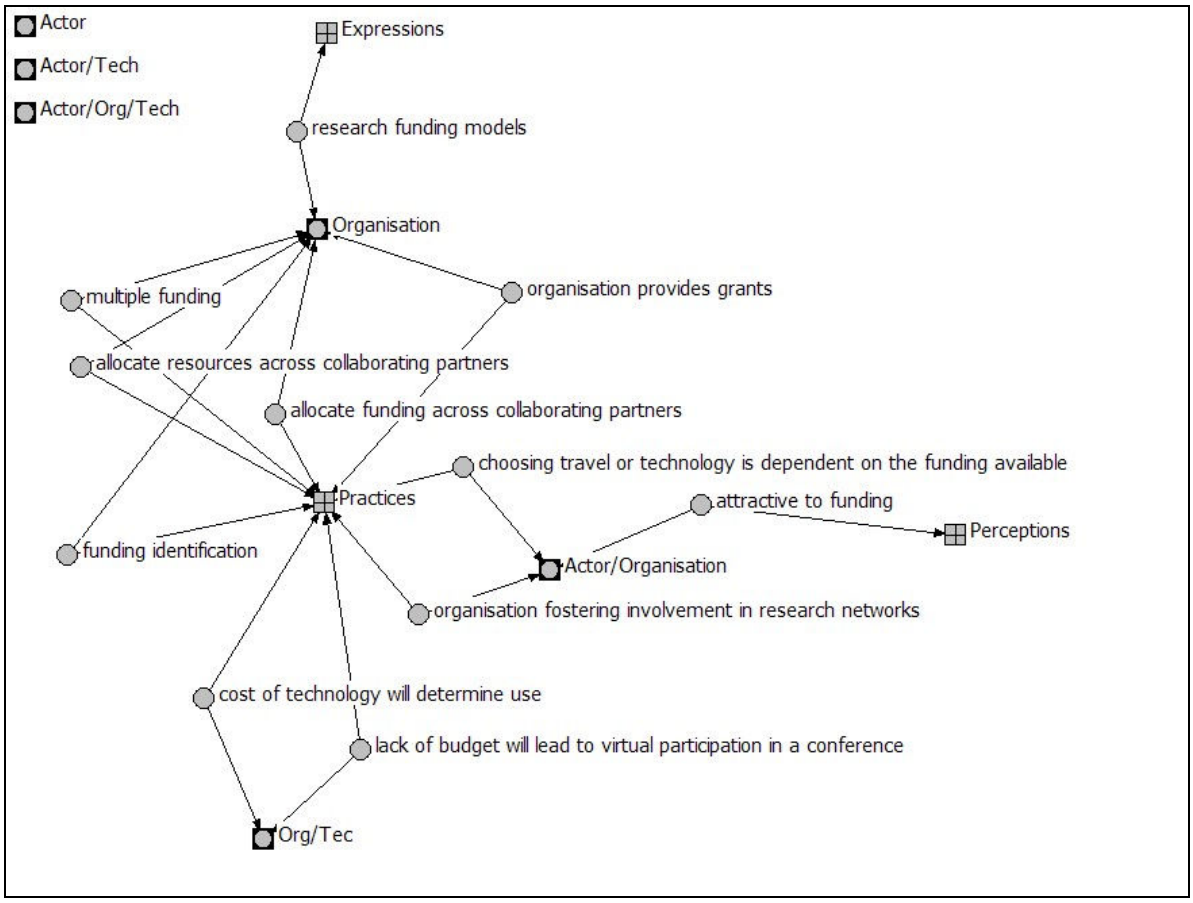


Figure 44- Factor System -Funding

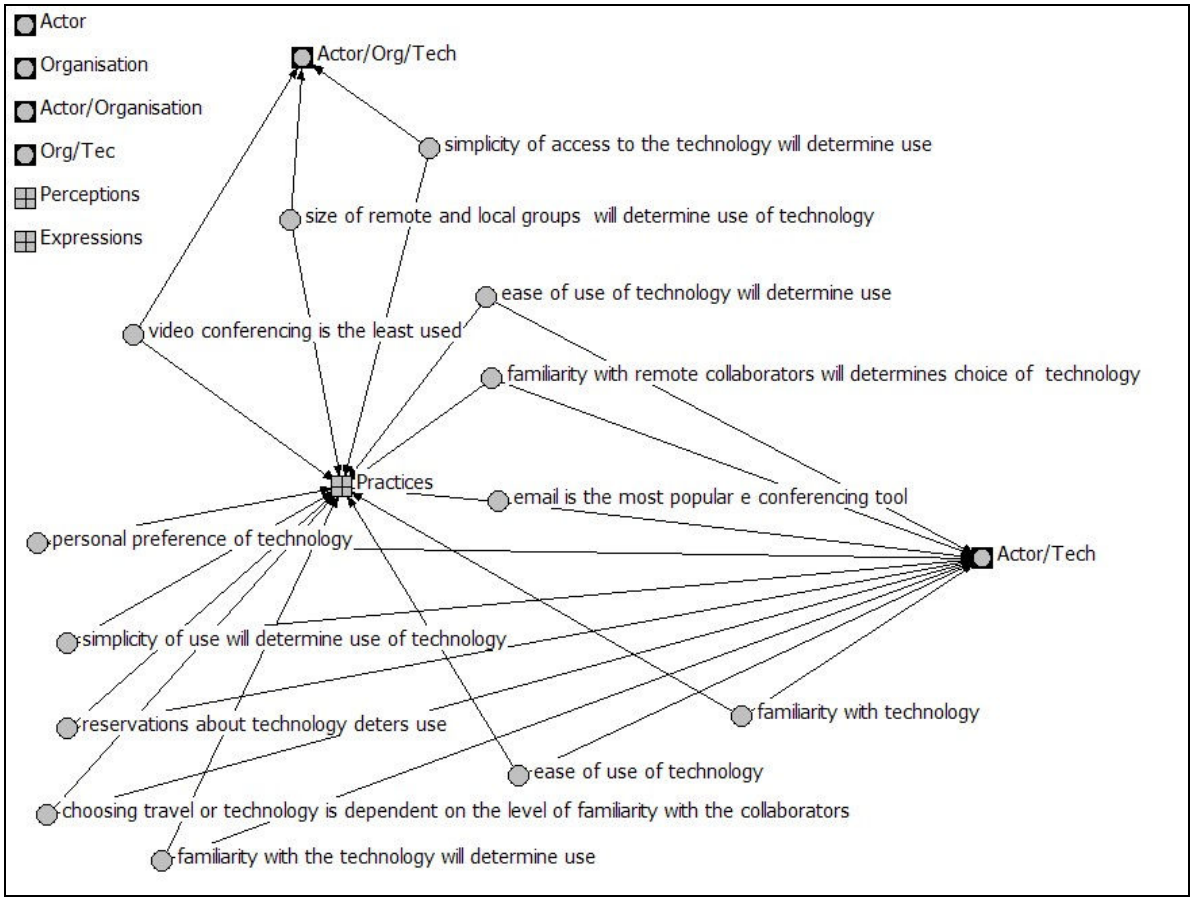


Figure 45- Factor System - User Technology

The entities of *statuses and agencies* tying statements within each *factor system* also serve in connecting all 29 factor systems and create the *Greater System* depicting the whole of uptake process. To identify how each *factor system* links to others Table 6 illustrates how ties created by the association of status and agency connect each of the 29 *factor systems* to the whole.

The acronyms used in the table 6 are as follows:
A=Actor
O=Organisation
AO=Actor Organisation
AT= Actor Technology
OT=Organisation Technology
AOT=Actor Organisation Technology
# = number of statements

Table 6- Association of Agency affiliated Statements to Statuses

Factors	Perceptions	Practices	Expressions	Total statements to factor
Barriers to collaboration	AO3	O3, AO2	O1	9
Collaboration value for Complexity	A1, AO1	AO1	O1	4
Collaborative culture	O3, AO6	O4, AO4	O1	18

Factors	Perceptions	Practices	Expressions	Total statements to factor
Collaborators	AO1	AO3	AO2	6
Competitiveness	O1	O1		2
Context	O1	O1		2
Diversity	A1, AO1	A1, AO2		5
Efficiency	O1	O2		3
Environment		AO2		2
Expectations of e conferencing	AO2	AO2		4
Face-to-Face		A1, AT1		2
Funding	AO1	O5, AO2, OT2	O1	11
Going virtual		AO5		5
Human Nature and Collaboration	A3	A2		5
Multidisciplinary		O1	O1, AO1	3
Networking	A1, AO1	A1, AO1	AO1	5
Organisational support		OT1		1
Quality of work	AO5			5
Rhetoric Practice gap	O2	O2		4
Standard practice	O2, AO1	O1	O2	6
System of factors	AOT1			1
Task Technology		AT4, AOT1,AO1		6
Technological support	OT1	OT3, AOT1		5
Technology Availability	OT1	OT1, AOT4		6
Technology Reliability		AT1, OT1		2
Time	AO1	AO1		2
Travel		A2		2
User Technology		AT10, AOT3		13
Work Relations	AO1			1
Total				140

Table 6 indicates the number of statements associated with the agency in the status column. Although Table 6 depicts all the relationships in the Greater system, following its visual representation is cumbersome. Providing a clearer view of the relationships is enabled through Graph Theory. In preparing the data for visualisation via Graph Theory, table 6 was transformed into a matrix showing in table 7.

Table 7-Matrix statements to status and agency

Factors	Perceptions	Practices	Expressions	Actor	Actor/Org	Organisation	Actor/Technology	Org/Tech	Actor/Org/Tech	Tech
Barriers to collaboration	3	5	1		5	4				
Collaboration value for Complexity	2	1	1	1	2	1				
Collaborative culture	9	8	1		10	8				
Collaborators	1	3	2		6					
Competitiveness	1	1				2				
Context	1	1				2				
Diversity	2	3		2	3					
Efficiency	1	2				3				
Environment		2			2					
Expectations of e conferencing	2	2			4					
Face-to-Face		2		1			1			
Funding	1	9	1		3	7		2		
Going virtual		5			5					
Human Nature and Collaboration	3	2			5					
Multidisciplinary		1	2		1	2				
Networking	2	2	1	2	3					
Organisational support		1						1		
Quality of work	5				5					
Rhetoric Practice gap	2	2				4				
Standard practice	3	1	2		1	5				
System of factors	1								1	
Task Technology		6			1		4		1	
Technological support	1	4						4	1	
Technology Availability	1	5						2	4	
Technology Reliability		2					1	1		
Time	1	1			2					
Travel		2		2						
User Technology		13					10		3	
Work Relations	1				1					

Table 7 depicts the number of statements associated with agencies and statuses identified within each *factor System* across the whole of the Greater system.

Using Graph Theory Figure 46 illustrates how the various factor systems are linked through *agencies* and *statuses*. These provide mutual channels through which all 29 *factor systems* are linked to create the Greater system showing the uptake system as a whole. Each *factor system* in figure 46 is represented by the title of the *factor system*.

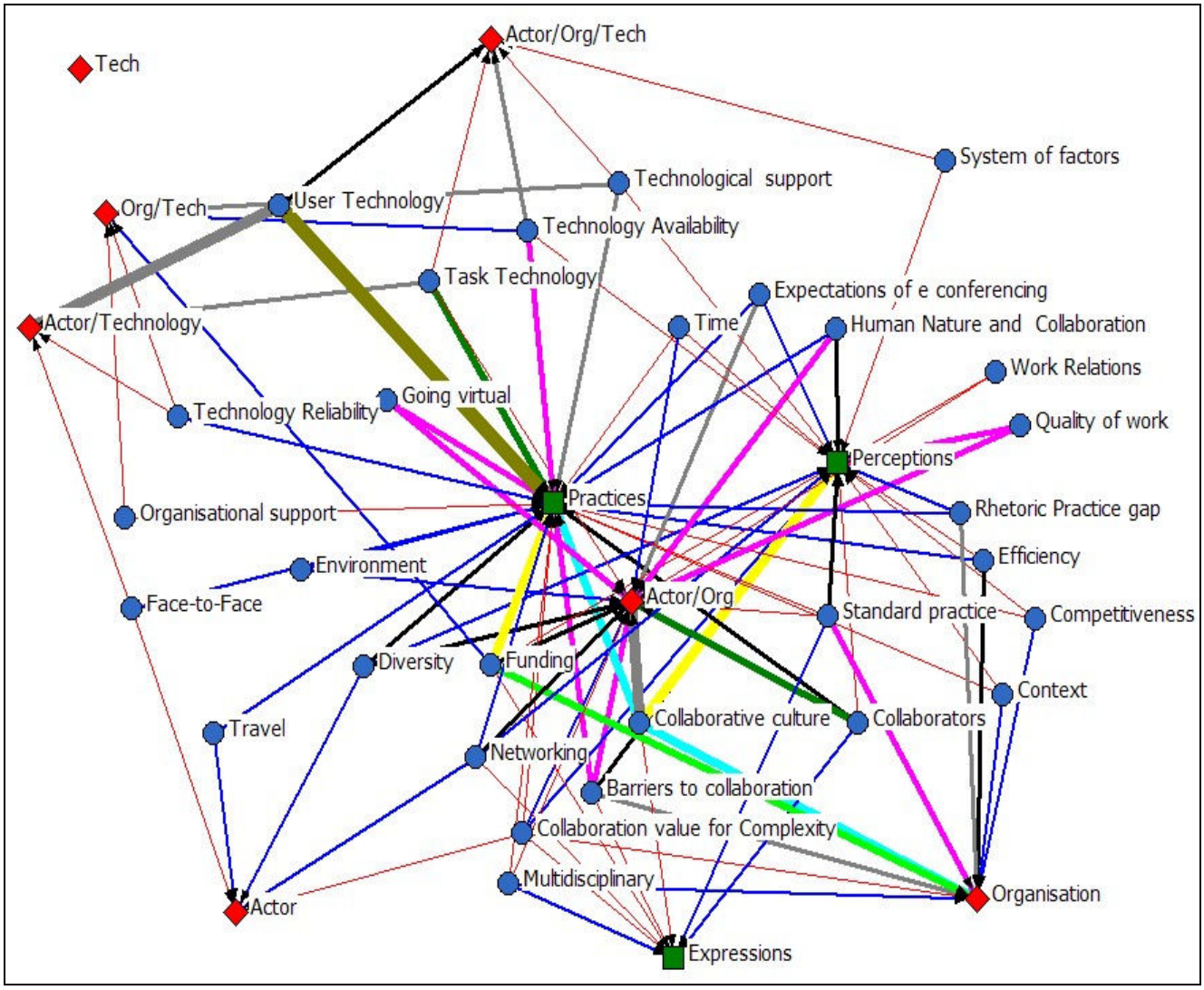


Figure 46 - The Greater System

The thickness of the lines linking *factor systems* in figure 46 depicts the strength of the relationships between factor systems and other elements in the system. Building on Social Network Analysis, "The thicker the line, the stronger the tie". Thickness is determined by the number of statements associated with each element as shown in Table 7. To demonstrate this phenomenon, Figure 47 illustrates a sample of four of the most prominent *factor systems* in the Greater System.

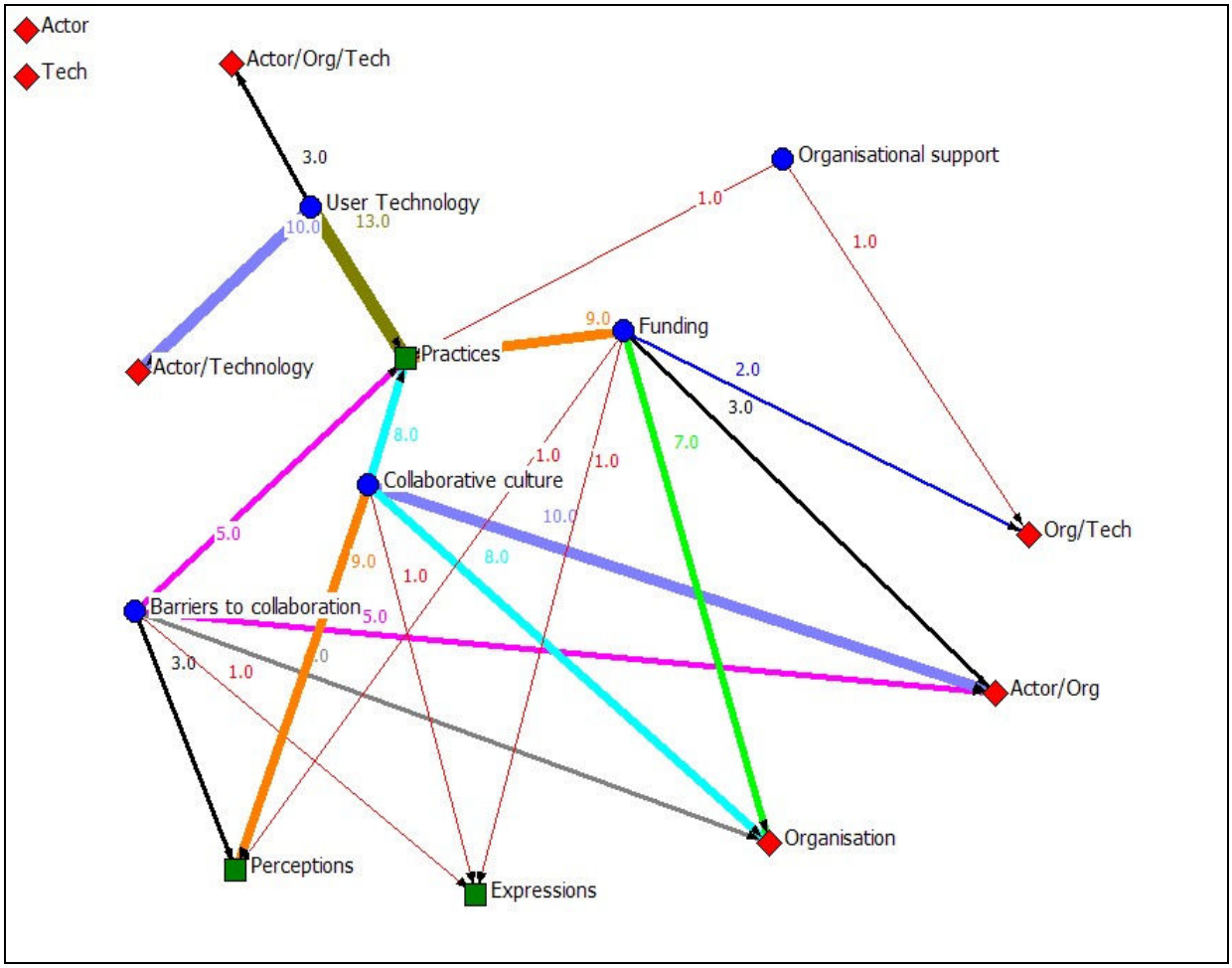


Figure 47- prominent factor systems strength of ties

Identifying the four most prominent factor systems showing in Figure 47 is enabled by measuring the strength and breadth of their ties within the Greater System.

The thickest line showing in Figure 47 is the one linking factor system *User Technology* with the status of *Practices.* The thickness of the line is the result of the relatively high number of statements from within the factor system associated with practices (13), indicating a strong tie between the two. However, the highest number of links across various entities within the Greater System goes to the factor system '*Collaborative Culture*', rendering it a high 'Centrality' measure. The more ties are associated with a *factor system* the higher its prominence or *Centrality*. Table 8 depicts the prominence of all the factor systems within the Greater system as determined by the number of ties linking each *Factor System* to the *Greater System*.

Table 8- Number of ties per factor system

Factors	no of ties
Collaborative culture	36
User Technology	26
Funding	22
Barriers to collaboration	18
Collaborators	12
Standard practice	12
Task Technology	12
Technology Availability	12

Factors	no of ties
Diversity	10
Going virtual	10
Human Nature and Collaboration	10
Networking	10
Quality of work	10
Technological support	10
Collaboration value for Complexity	8
Expectations of e conferencing	8
Rhetoric Practice gap	8
Efficiency	6
Competitiveness	4
Context	4
Environment	4
Face-to-Face	4
Multidisciplinary	4
Technology Reliability	4
Time	4
Travel	4
Organisational support	2
System of factors	2
Work Relations	2

The four most prominent factor systems are those showing the highest number of ties at the top of the table. The least prominent factor systems are at the bottom.

The most prominent factor systems are:

1. Collaborative Culture with a total number of 36 ties
2. User technology with a total number of 26 ties
3. Funding with a total number of 22 ties
4. Barriers to Collaboration with a total number of 18 ties

A detailed description of the processing of the data entailed in the method is described in appendix 1.

Analysis of the Greater System- the Prioritisation of factor systems

The prominence of a factor system can be determined according to two measures:

1. Strength of ties- the number of statements linked to a status of agency
2. Breadth of ties – the number of ties linking across statements, statuses and or agencies

The thickness of ties, the position of the various *factor systems* illustrated in the Greater System (figure 46), and its relations to other elements in the *Greater System* marks the prominence of each *factor system* and consequently the impact value it holds in relation to the process as a whole. Identifying the prominence of a *factor system* facilitates the prioritisation of highly prominent system factors over low prominence ones.
Prioritisation can be done using either one of the two prominence measurements mentioned above.

Figure 46 shows a thick tie link between the factor system *user technology* and *practices*. Thickness of a tie indicates high number of statements associated with the factor, which

indicates a strong tie and potential prominence. However, Social Network Analysis approach would argue that importance of a node in a network is often decided by the breadth of the tie, indicated by the number of ties stretching across other nodes in the network. Nodes showing high numbers of relations to other nodes are seen as being extremely involved with other nodes and are therefore perceived as highly central, or in Social Network Analysis terminology, hold high *Centrality* levels (Wasserman & Faust, 1994). Strength of ties may be crucial in some context whereas in others the breadth of ties will have a greater impact.

Measuring the prominence of *factor systems* enables to ascertain the level of impact attributed to various factors in the system, and so inform decision makers of the importance of factors and enable them to prioritise. Prioritisation of the factor systems will enable decision makers to break down the implementation process into manageable segments without losing sight of the system as a whole. The prioritisation of *factor systems* facilitates addressing parts of the whole but not by dealing with individual factors but by addressing *factor systems* as subsystems interlinked to the Greater system representing the process as a whole.

Summary of Systems' Approach

Analysing the visual illustration of the Greater system it is apparent that technology can never be seen as an independent entity. Figure 46 shows that technology in itself was excluded from the system because it was never mentioned as an isolated entity in the findings. This indicates that technology is not the driver of its own uptake. The argument that there is more to the use of technology than its mere provision has been raised by the author in a pervious study in which applied a Bourdieuean *habitus and field* framework was applied to the study of the construction of technology by agencies other than designers/developers and users(Allan & Thorns, 2009). Applying the Bourdieuean framework here could have identified the *status* in which a *statement* is found as constructing the *Habitus* or *Practices* comprising the uptake process, while the *agencies* could have been perceived as constructing the *Field* or the social world, the users. However, the amount of variables and the breadth of their interrelatedness and the need to organise them in a way which will enable practical implementation in a non binary approach suggested that a different framework is needed. The choice fell on System theory as it can provide a conceptual model which can be applied across different phenomena. Furthermore, it is particularly useful in the implementation of processes such as uptake of technology particularly in large organisations, because System's approach incorporates equally maintenance and change, preservation of system and internal conflict(Bertalanffy, 1971)

Summary and Conclusions

The report shows that technology in itself does not drive change.

The most prominent factor systems identified in the Greater system of uptake of e conferencing technologies is collaborative culture, seconded by the relationship between users and technology. Funding and barriers to collaboration hold the third and fourth place in impact value.

The report concludes that the implementation of innovation is a complex process involving numerous interrelating factors and that these should be addressed as systems and subsystems of factors rather than be approached as isolated variables affecting the process.

The project suggests that for e-conferencing technologies to be successfully implemented a whole systems approach is needed. However, to enable decision makers a realistic way of addressing the system as a whole the project introduces a new approach which prioritises rather than isolates factors.

The findings in this project exposed the complexity of the uptake process as embedded in issues relating to collaboration, collaborative culture, and organisational awareness and understating of what is entailed in translating 'green' remote collaborative desires to actual practices. The report suggests that for successful uptake there is a need for taking into consideration users' perceptions of the remote collaborative technology, users' requirements and expectations of the technology and of the organisation within which they work.

The report argues that for uptake to be successful there is a need for bridging the gap between the rhetoric and practices currently at play in the e conferencing for sustainable practices arena. The report argues that to bridge the gap there is a need for a shift in the way we address uptake. The report suggests using systems approach which enables to identify how various aspects of the process are linked. It is argued that understanding the links facilitates following the uptake process as an emergent phenomenon where the 'whole' is something greater than the sum, but at the same time reveals the points through which the 'whole' is assembled. These can be used as intervention points for facilitating successful uptake.

The report concludes that the implementation of innovation is a complex process involving numerous interrelating factors and that these should be addressed as systems and subsystems of factors rather than be approached as isolated variables affecting the process.

The report argues that the problem lies in the basic perceptions underlying current implementation approaches and argues that there is a need for a new model of thinking. The paper proposes a model based on Systems Thinking. It addresses technical and non technical factors and clusters them into subsystems which comprise the greater system constructing the process as a whole. The model enables to administer the implementation process in manageable yet interconnected segments of a multi factor system.

The project acknowledges the strategic problems of implementing uptake from within a system's approach framework. To enable decision makers a realistic way of addressing the system as a whole the project introduces a new approach which prioritises rather than isolates factors. The most prominent factor systems identified in the Greater system of uptake of e conferencing technologies is collaborative culture, seconded by the relationship between users and technology. Funding and barriers to collaboration hold the third and fourth place in impact value.

The project proposes a *'relational prioritisation'* in which prioritisation is decided according to the levels of connectivity of individual factors within their subsystems, and indicated levels of connectivity of subsystems within the whole. It is argued that highly connected parts should be prioritised over lower connected ones.

The approach proposed in this project enables addressing various parts of the system entailed in the implementation process while acknowledging the connectedness of the parts to the whole. This is enabled using concepts adopted from Social Network Analysis (SNA), and illustrated using Graph Theory techniques.

Recommendations

Organisations need to treat the implementation of e conferencing for reducing travel as a Complex System comprised of multiple subsystems which have to be woven into the existing organisational and contextual systems.

Decision makers should approach the implementation of e-conferencing tools for reducing travel as a double tiered problem:

Tier 1 - Analysis

- Identify what factors are entailed in the process as a whole
- Identify what constitute each factor, and map the relationships between the various aspects comprising the factor
- Identify the impact value of various factor systems in the Greater system based on the factor system's prominence and centrality

Tier 2 – Implementation

- Use the information obtained in tier 1 to approach the implementation of e conferencing process as a complex system and address all the factors involved in a manner which will reflect their interrelatedness in the system as a whole. Mange the process by prioritising factor systems according to their position in the system
- Use the view enabled by the analysis tier to identify points of intervention in the implementation process

The project proposes that parts of the analysis tier would be automated to enable efficient ways of producing analysis reports for the support of informed decision making and intervention strategies for the implementation tier.

The methodology described here can serve as a verbal model for the automisation. Literature shows that it is better than no model – history of science asserts that expression in ordinary language often preceded mathematical formulation - i.e. the invention of algorithm (counting in words in Roman times preceded numbers)(Bertalanffy, 1971).

The approach proposed in this project can be applied as a generic model to be used in various innovation implementation processes particularly in the area of technology or sustainability related practices as these pose large numbers of interrelating factors.

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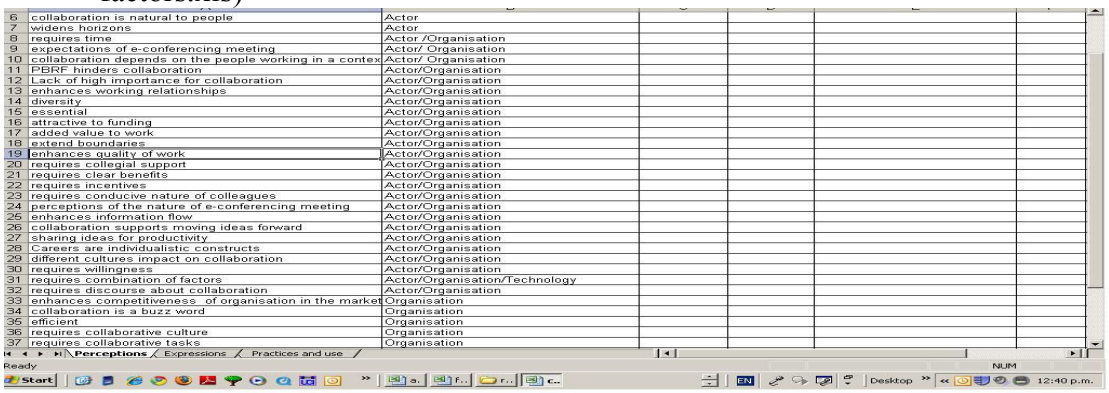
Appendix 1

1. Construct questionnaire that will address operational or preoperational aspects like- perceptions, practices and expressions of those in the work place
2. Create an MSWord or Excel file where you list all statements made by survey/ interviews participants and cluster them according to the areas in which they were uttered (perceptions, practices, expressions)
3. Create Excel file with three sheets each presenting an operational or pre-operation aspect (i..e one sheet for perceptions one for practices, etc)where statements are associated with agency as emerging from the wording of the statement (actor, actor/organization, organisation etc) as shown here (xls file called - collaboration factors.xls)



4. Create Excel file in which statements are clustered into overarching Factors- i.e. collaboration, technical support, work practices, barriers etc.) as shown in 'actor organisation tech.xls'
5. Reorganise actor organisation tech.xls into 'statement to factor.xls, which shows statement clustered into factors categorised by operational aspects and related to agency sheets (each exl sheet shows a different agency) which was used to create the meta matrix
6. Create a meta- matrix as shown here (demo data): use statement to factor.xls as data resource, and factors summary lists as check list and information to how many rows are needed for each factor)

factors	Statement	Agency Actor(A)	Agency Organisation(O) etc.	Operation Aspect Perceptions	Operation Aspect Practices	Operation Aspect Expressions
Factor 1	Statement 1	1		1		1
	Statemnet2					
	Statement3					
Factor 2	Statement 1		1	1	1	

7. Cut the meta matrix into sub matrices (separate xls sheets for each factor)each containing a single **Factor System – that is the statements associated with one**

factor that is - the agencies and operational aspects it was involved in (see example in Factor systems.xls)

8. Use one factor system sheet from the meta matrix to upload to UCINET.
9. perform density routine using:
    - Copy each factor system into an excel sheet name it after factor (delete first row – empty)
    - Import to UCINET using "import data" – tick Full Matrix – save file – named by factor
    - Bipartite non symmetric to prepare data for density measures.
    - Networks- Cohesion- Density-Density overall (utilise diagonal – not ticked)
10. To show connectivity use Kcore function (using factor system centrality bipartite in UCINET – Networks. regions. K core
11. Use the sub matrices to upload to NetDraw to produce visual systems of each factor in which its statements appear as participants affiliated with the various entities (agencies and operation (practices, perceptions etc)in the network - creating FACTOR systems/networks.
12. preparing for NetDraw
    - Copy each factor system into an excel sheet name it after factor (delete first row – empty)
    - Import to UCINET using "import data" – tick Full Matrix – save file – named by factor
    - Transform to bipartite **non sym** for each factor
    - Open bipartite in Netdraw – produce graph
    - Change node – symbol – shape to differentiate statement- agencies - operation

13. Copy density results from UCINET reports to an xls file to show the highest density factor system within the whole of the system

Factor	density	No of ties
Factor1	#	#
Factor2	#	#

Produce graphs of each factor and present in a table

Graph factor 1	Graph factor3
Graph factor2	Graph factor4

To visualise whole system relations:

- Translate the data shown as an example in factor summary lists.xls to a valued graph as shown in 'factor system centrality New.xls. (it is total number of statements in each column – including the cluster of practices perceptions etc. and the agencies actor, org. etc.
- In UCINET - Using *import text data* upload the value graph table to UCINET
- Run Bipartite routine on the factor system centrality valued graph
- Using NetDraw to produce graph out of the bipartite matrix
- Use value of strength of ties(properties >line> size> ties strength (indicate max9) to show which factors are most strongly connected.